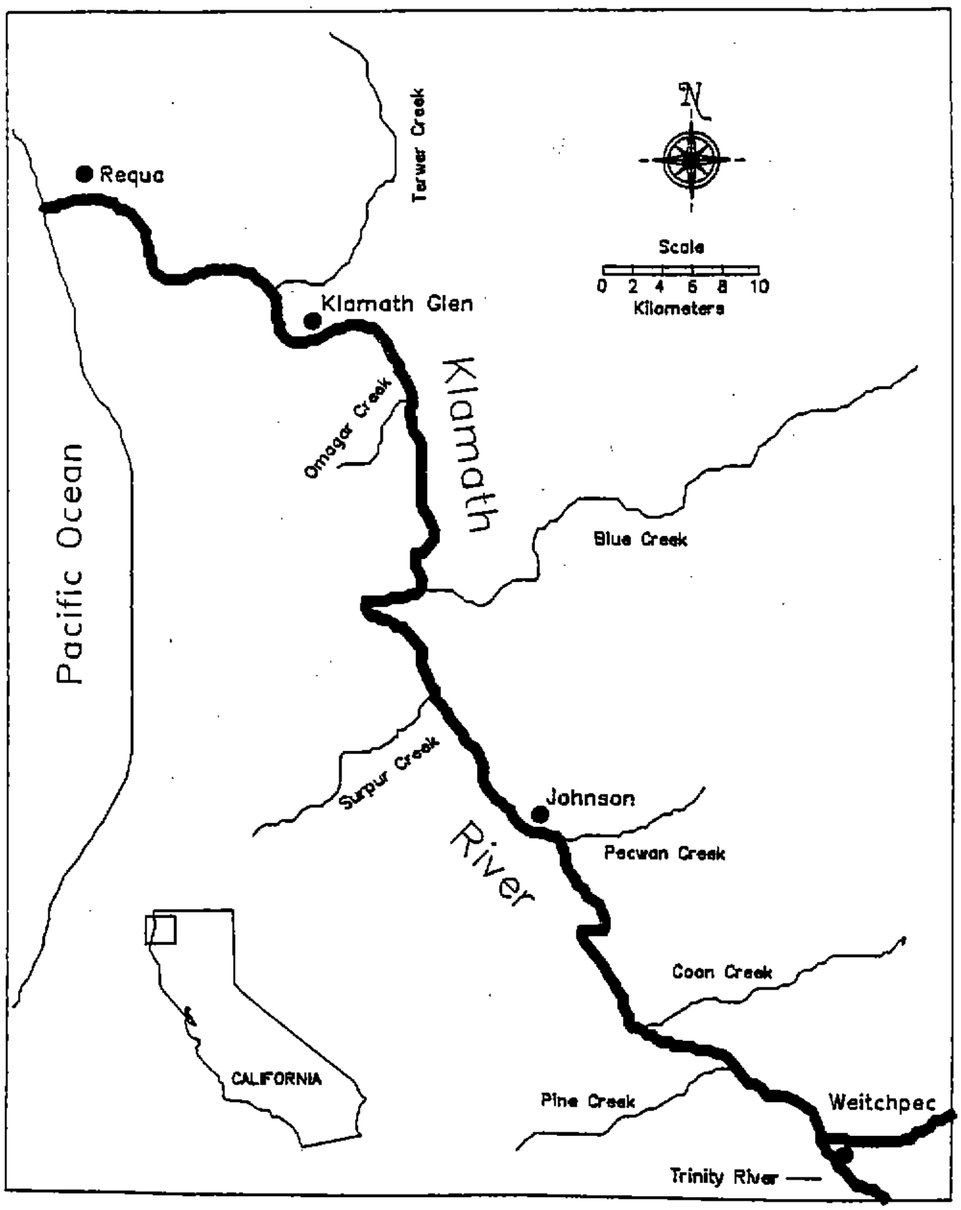
KLAMATH RIVER FISHERIES ASSESSMENT PROGRAM

ANNUAL REPORT 1989

March 1991

U.S. Fish & Wildlife Service
Coastal California Fishery Resource Office
Arcata, California



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Arcata, California

REPORT NO. AFF1-FRO-91-14

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March 1991

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LIST OF ACRONYMNS AND ABBREVIATIONS

ad-clip	- Adipose fin-clip
CDFG	- California Department of Fish and Game
cm	- Centimeters
CWT	- Coded Wire Tag
DOI	- U.S. Department of the Interior
CCFRO	- Coastal California Fishery Resource Office
FWS	- U.S. Fish and Wildlife Service
HVR	- Hoopa Valley Indian Reservation
IGH	- Iron Gate Hatchery
kg	- Kilograms
km	- Kilometers
KRFMC	- Klamath River Fishery Management Council
KRSMG	- Klamath River Salmon Management Group
mm	- Millimeters
n	- Sample size
PFMC	- Pacific Fishery Management Council
s	- Standard deviation
TRH	- Trinity River Hatchery
USFS	- U.S. Forest Service
$\bar{X}$	- mean
YIR	- Yurok Indian Reservation

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ANNUAL REPORT

KLAMATH RIVER FISHERIES INVESTIGATION PROGRAM

1989

FORWARD

The Klamath River watershed drains approximately 14,400 km^2 in Oregon and 26,000 km^2 in California. The majority of the watershed in California is within the boundaries of the Six Rivers, Klamath and Shasta-Trinity National Forests. The Yurok Indian Reservation, comprising approximately 139 km^2 in Humboldt and Del Norte counties, borders the lower 68 km of the Klamath River (Figure 1). The most important anadromous salmonid spawning tributaries in the basin include the Trinity River (the largest tributary in the drainage) draining approximately 7,690 km^2, and the Shasta, Scott and Salmon Rivers, each draining approximately 2,070 km^2. Iron Gate Dam on the Klamath River (river km 306) and Lewiston Dam on the Trinity River (river km 249) represent the upper limits of anadromous salmonid migration in the basin. Iron Gate and Trinity River Hatcheries located near the base of each dam, were constructed as mitigation for natural fish production losses resulting from each project.

The Klamath River Basin has historically supported large runs of chinook salmon (Oncorhynchus tshawytscha) and steelhead trout (O. mykiss), which have contributed considerably to subsistence, sport and commercial fisheries in California. Generations of Indians have utilized fishing grounds in the drainage, and their fisheries for salmon, steelhead and sturgeon have historically provided the mainstay of Indian economy in the area. Sport fishing for salmon and steelhead in the drainage may exceed 200,000 angler days annually. In addition Klamath River stocks account for up to 30% of commercial chinook salmon landings in northern California and southern Oregon and have averaged approximately 450,000 chinook per year over the last decade (PFMC 1988). The USFS estimated an annual net economic value of salmon and steelhead fisheries attributable to USFS lands in the Klamath River Basin in excess of $20 million and mean annual net economic values per kilometer of chinook salmon, coho salmon (O. kisutch), and steelhead trout habitat in the basin of $15,600, $1,400 and $2,800, respectively (USFS 1977, USFS 1978). In 1980, the Department of the Interior included the Klamath and Trinity Rivers in the National Wild and Scenic Rivers System. Portions of the Klamath and Trinity Rivers are also under California state classification as Wild and Scenic Rivers.

Concern about the depletion of anadromous salmonid resources and associated habitat in the basin emerged around the turn of the century, and has accelerated in recent decades coincident with expanded logging and fishing operations, dam building activity, road construction and other development. As in other river systems of the Pacific Northwest, chinook salmon of the Klamath River Basin have experienced the continued effects of habitat degradation and over-exploitation as reflected by declining runs in recent decades.

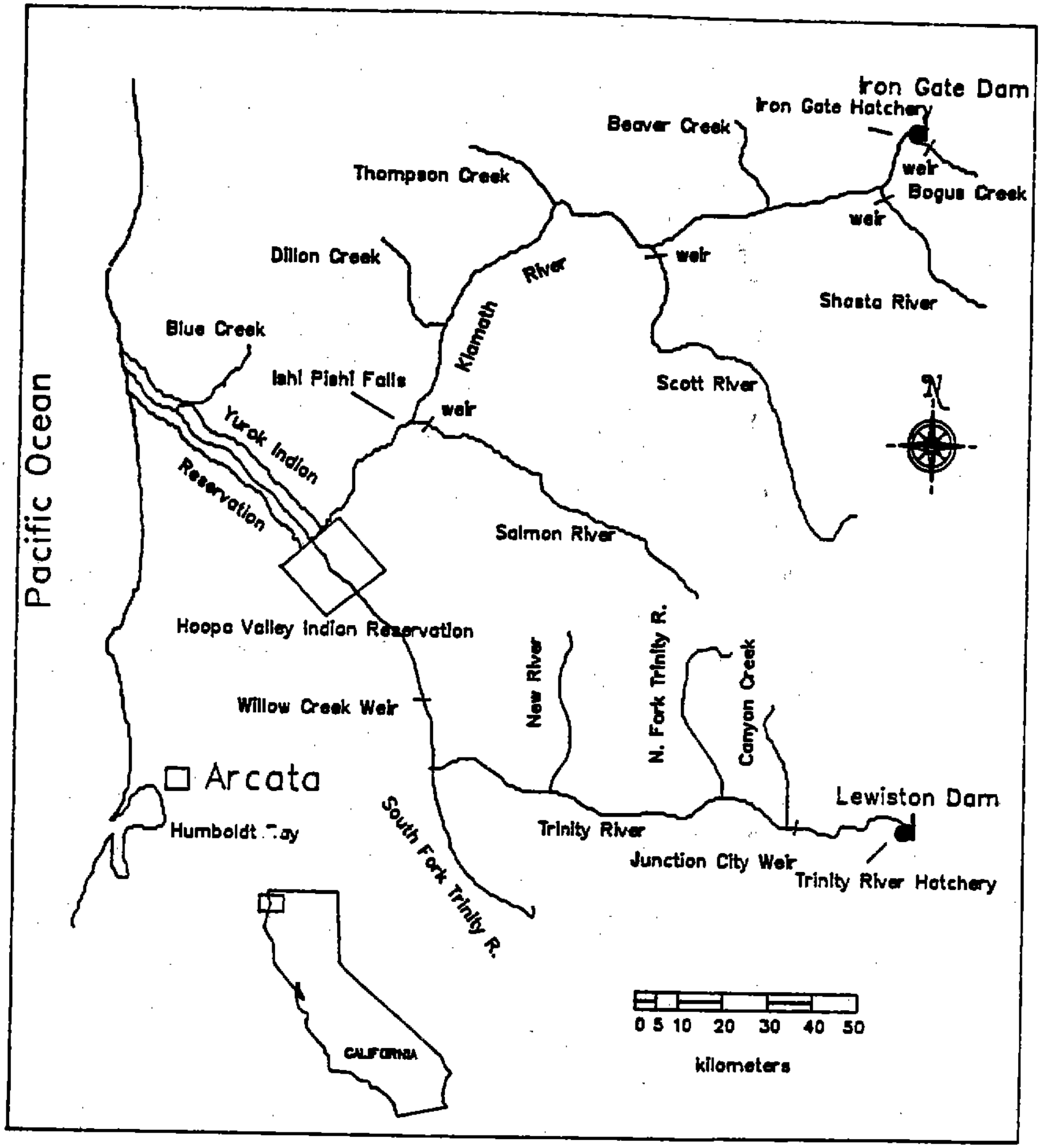

FIGURE 1. Overview map of the Klamath-Trinity River basin accessible to anadromous fish.

In response to habitat problems resulting from the Trinity River Division project, the Congress enacted P.L. 98-541; the Trinity River Basin Fish and Wildlife Management Program on October 24, 1984. This action directs the Secretary of the Interior to restore fish and wildlife populations in the Trinity Basin to levels approximating those which existed immediately before the start of construction on that project. An office administered jointly by the U.S. Bureau of Reclamation and the U.S. Fish and Wildlife Service was recently opened to oversee work under P.L. 98-541.

In 1985 CH_2M Hill, a consulting firm, completed a document entitled "Klamath River Basin Fisheries Resource Plan", through contract with the Department of the Interior, Bureau of Indian Affairs (DOI 1985). This plan details restoration actions for the remainder of the Klamath Basin which are similar to those included in the Trinity River Basin Fish and Wildlife Management Program described above.

Since passage of the Magnuson Fishery Conservation Management Act of 1976 (16 U.S.C. 1801-1882) and the promulgation of the first set of Federal fishing regulations governing Indian fishing on the HVR in 1977, considerable attention has also focused on the fisheries operating on the depressed chinook salmon runs, notably the ocean troll fisheries and the Indian gill net fishery on the Klamath and Trinity Rivers. In 1985, the KRSMG was formed to provide recommendations for the management of the combined fisheries operating on Klamath River chinook stocks. In 1986, the KRSMG provided recommendations concerning allowable levels of harvest for all Klamath stock fisheries.

On October 27, 1986 the Congress enacted P.L. 99-552, the Klamath River Fish and Wildlife Restoration Act. This action authorized the Secretary of the Interior to restore the anadromous fish populations to optimum levels in both the Klamath and Trinity Rivers through a habitat restoration program and formation of the Klamath River Fishery Management Council which replaced the KRSMG.

The Assistant Secretaries of Indian Affairs and Fish and Wildlife and Parks, in addressing Departmental resource and Indian Trust responsibilities concerning the Klamath River Basin resource and YIR, have entered into annual fiscal Interagency Agreements providing for fisheries investigation programs focusing on the monitoring and evaluation of chinook salmon runs in the Klamath River, and the monitoring of Indian net harvest levels on the YIR. This is the eleventh in a series of annual reports covering the Klamath River Fisheries Assessment Program, conducted through CCFRO, Arcata under the Fiscal Year 1989 Interagency Agreement.

The program consists of three major groupings of related activities:

(1) Beach Seining Operations focus on:

(a) the provision of age composition data required to forecast annual Klamath River chinook ocean population abundance; and

(b) the annual monitoring of fall chinook runs to evaluate natural/hatchery composition, to assess hook scarring and gill net marking incidences, to collect age-growth, length frequency and length-weight data and to provide information on run timing and migration patterns.

(2) Harvest Monitoring and Evaluation Efforts focus on:

(a) the annual estimation of the Indian net harvest levels on the YIR involving chinook salmon (spring and fall runs), steelhead trout (fall run), coho salmon, and green sturgeon (*Acipenser medirostris*);

(b) the collection and reading of coded-wire tags recovered from the net fishery during harvest monitoring activities and use of this data in statistical evaluation of the various tagged release groups through their occurrence in the ocean and in-river net fisheries; and

(c) the annual monitoring of chinook and coho salmon, steelhead trout and green sturgeon runs to evaluate natural/hatchery composition, to assess length frequency, age-growth and length-weight relationships within the harvest.

(3) Technical Assistance involves:

(a) participation in various technical committees including the Technical Advisory Team to the KRFMC;

(b) the provision of general technical assistance, as requested, to the CDFG, BIA, HVBC Fisheries Department, other branches of the FWS and various other groups and agencies; and

(c) the conduct of various other field studies in the Klamath River Basin as is deemed appropriate.

Methods utilized and results obtained during 1989 through these program activities are detailed in sections summarizing data collected on chinook salmon, coho salmon, steelhead trout, sturgeon and shad. During 1983 the HVBC Fisheries Department assumed responsibility for harvest monitoring programs covering the Trinity River portion of the HVR, formerly a part of CCFRO, Arcata responsibilities. This responsibility remained with the Hoopa Tribe during 1989. It should, therefore, be realized that harvest data presented in this report, unless otherwise noted, are not strictly comparable with harvest data presented in certain previous reports since the area of coverage has changed as described.

KLAMATH RIVER FISHERIES ASSESSMENT PROGRAM

ABSTRACT

During the fall run sampling period, 2,009 chinook salmon (Oncorhynchus tshawytscha) were captured in 304 sets during 1989 seining operations in the Klamath River estuary. Scales were collected from 1,772 chinook for age analysis. Age analysis from scale samples indicates an age composition of 4.8% 2-year-olds, 38.6% 3-year-olds, 53.3% 4-year-olds and 7.2% 5-year-olds. Tags were applied to 629 chinook for mark recapture analysis. Ad-clipped chinook comprised 7.2% of the sample. Gill net harvest on the Yurok Indian Reservation (YIR) during 1989 was estimated at 42,211 fall and 4,775 spring chinook. A total of 1,510 CWT, representing 40 fall and 5 spring chinook release groups, were recovered during mark sampling of the 1989 net fisheries on the YIR. These recoveries expanded to a total estimated harvest of 2,748 CWT fall and 656 CWT spring chinook in the 1989 net fisheries.

Seven coho salmon (O. kisutch) were captured during seining operations in the Klamath River estuary. Based on scales collected from 17 coho, age composition of the returning coho was 100% 3-year-olds. An estimated 525 coho salmon (14 jacks and 511 adults) were harvested in the Indian gill net fishery on the YIR in 1989. Ad-clipped coho comprised 5.5% of the sampled harvest. All 11 CWT recoveries were from release group 06-56-56.

Six hundred thirty-seven steelhead trout (O. mykiss) were captured during 1989 seining operations in the Klamath River estuary. The estimated harvest of fall steelhead by the Indian gill net fishery on the YIR was 219, including 8 half pounders.

One green sturgeon (Acipenser medirostris) was captured during 1989 beach seining operations. An estimated 268 green sturgeon and 34 white sturgeon (A. transmontanus) were harvested by the Indian gill net fishery on the YIR in 1989.

BEACH SEINING PROGRAM

INTRODUCTION

The 1989 beach seining season marks the eleventh consecutive year of monitoring efforts focused on the returning fall chinook salmon near the mouth of the Klamath River. This beach seining program was initiated by CCFRO, Arcata biologists in 1979 to collect data on Klamath River Fall chinook salmon, with emphasis upon collection of age composition data, run timing, hook-scarring, and other basic biological data. The age composition data have aided the estimation of ocean stock size of 3- and 4-year-old Klamath River fall chinook, and consequently, the mañagement of the ocean and in-river fisheries.

METHODS

Beach seining began on July 17, 1989 on the south spit of the Klamath River mouth, and ended on September 22, 1989 (Figure 2). Seining was conducted four days per week, on Monday, Tuesday, Thursday and Friday. Seining began at 0900 hrs and ended about 1330 hrs, after completion of eight sets, spaced at half-hour intervals. The river mouth area was chosen to sample the fall run of chinook prior to sustaining in-river harvest. Chinook salmon are known to migrate through deeper channels of cool, saline water within the mouth area. Thus, a seining site was chosen to sample the deeper channels and allow efficient sampling during most tidal stages. The channels were located and depth contours were mapped by a hydro-acoustic survey of the lower estuary one week prior to the seining season.

The seining was conducted by a seven person crew of biologists and technicians. A 150 m by 6 m beach seine net (5.4 cm bar mesh, with a 3.2 cm bar mesh bag) was deployed by a Valco jet boat and retrieved to shore with two gas-powered winches. Captured chinook were hole-punched in the caudal fin with a paper punch, measured to the nearest cm fork length (fl), examined for fin clips, and a scale sample was taken. These fish were also examined for hook scars, gill net markings (GNM), predator wounds and other distinguishing characteristics. A subsample of chinook were weighed to the nearest pound, and the weights were converted to kilograms (kg). Spaghetti-type reward tags (provided to CCFRO, Arcata by CDFG) were applied to adult chinook prior to release, as circumstances allowed.

The length statistics were computed from all fish captured and measured, unless noted otherwise. The scale age sample was selected systematically from the daily total catch to treat for bias resulting from an uneven field sampling regime.

The jack (two-year-old) and adult (three-year-old and older) length cutoff was obtained by selecting the nadir from the catch length-frequency distribution and from the age overlap between two- and three-year-olds. The scale samples were processed and aged, as described in the AGE COMPOSITION section of this report. The examination of fish for gill net marks and hook scars is a continuing effort to document fisheries impacts on Klamath River chinook salmon populations. Physical wounds attributable to hooking incidents were classified according to the criteria listed in Table 1.

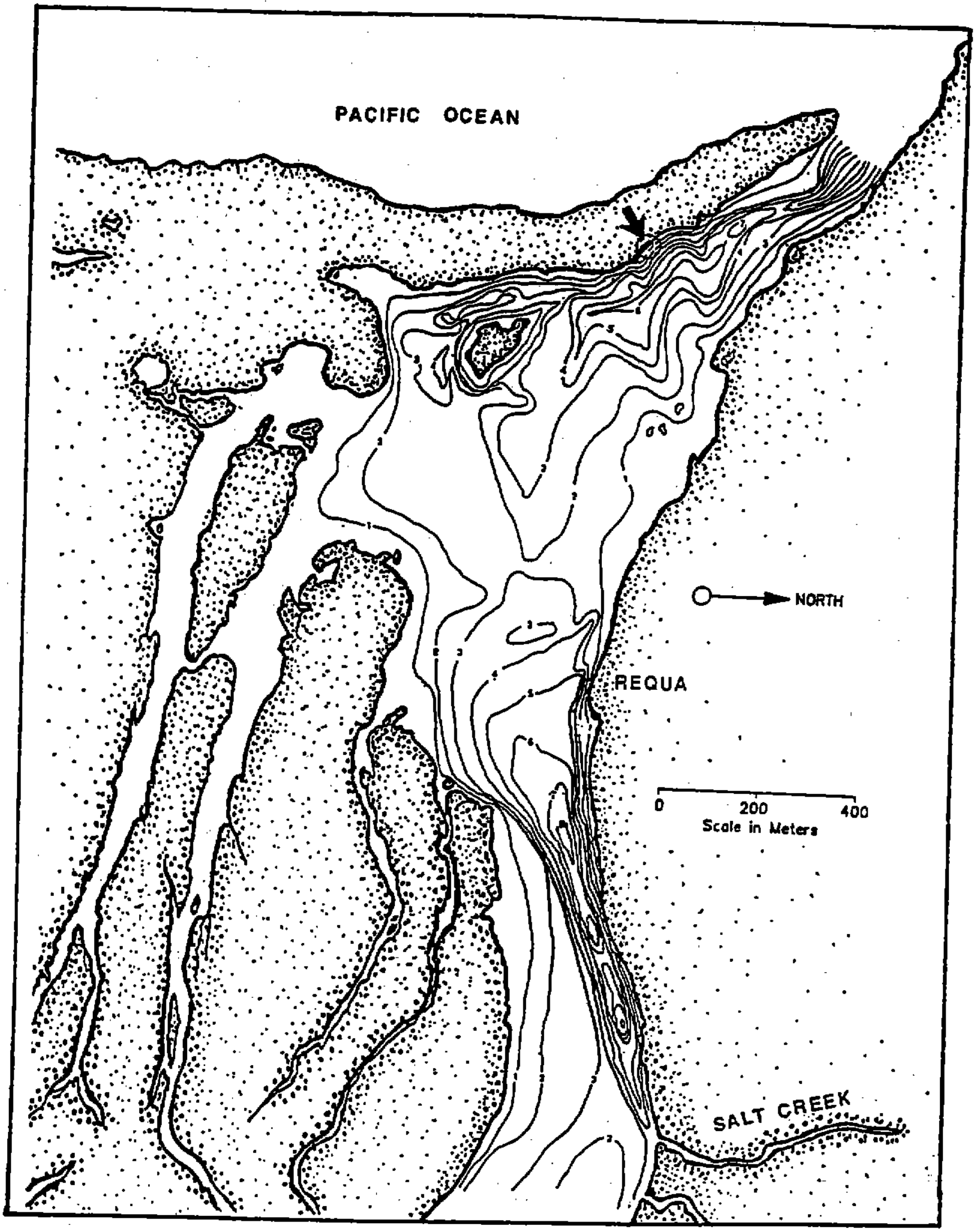

FIGURE 2. Map of the Klamath River estuary during 1989, depicting beach seining site (arrow) and depth contours (meters) as determined by fathometer soundings.

TABLE 1. Categorization of hook scars observed during 1989 beach seining operations in the Klamath River estuary.

Characteristic	Classification	Criteria for Classification
Freshness	Fresh	Open wound, whether bleeding or not. No substantial healing exhibited.
	Healed	Completely healed scar, or open wound exhibiting a state of near total healing.
Severity	Minor	Obvious wound or scar, but not extensive or deep.
	Moderate	Extensive or deep wound or scar. Major vital structures intact.
	Major	Extensive or deep wound or scar. Vital structures missing or shredded. Debilitating damage (e.g. blindness).
Location	Upper Jaw	
	Lower Jaw	
	Eye and Orbit	
	Opercle	
	Isthmus	
	All Other Head Areas (Includes nose, inside mouth and top of head)	

On five seine hauls, large numbers of captured chinook precluded total sampling, within these sets, every other chinook was sampled in the manner described previously; other chinook were released without examination. This sub-sampling was done to minimize holding time and stress.

The catch statistics and other analyses are based on all measured chinook (recaptures excluded), unless indicated otherwise.

RESULTS AND DISCUSSION

Catch Statistics

The following analyses are based on 1,734 chinook examined (recaptures excluded) during the seining operation. The chinook are assumed to be the fall race, based on CWT analyses of chinook captured in the estuary gill net fishery. July 15 was determined to be the cutoff date between the spring and fall runs of chinook (see NET HARVEST section). A total of 503 length-weight samples were collected in 1989. The jack/adult length cutoff was determined to be 55 cm, from methods described previously. For length at age analyses and comparisons between seasons, refer to the AGE COMPOSITION section.

During 1989, 2,009 chinook were captured in 304 seine hauls. Of this total, 100 were jacks (<56 cm fl), and 1,634 were adults (>55 cm fl). The remaining 275 fish consisted of 261 chinook that were released (not sampled), and 14 recaptures. Of the 1,734 chinook measured, scale samples were collected from 99 jacks and 1,623 adults. The mean length of all measured jacks was 47.9 cm, and represented 5.8% of the sampled catch, while adults averaged 74.5 cm, and comprised 94.2% of the catch (Figure 3). The first chinook was captured on July 20, the peak catch (n=362) day was September 11, and the peak catch week (n=571) occurred during the 8th week of sampling (September 4-8).

The mean fork length of the age sample jacks and adults was 49.8 cm, and 74.4 cm, respectively. The aged jacks were significantly larger ($p<0.05$) than all measured jacks. This is explained by a combination of factors. First, several aged two-year-olds were larger than 55 cm cutoff. Also, the jack-adult cutoff is a artificial concept intended to delineate an theoretical division between age classes, and ignores any actual overlap of ages. However, the mean size of bio-sample jacks (48.7 cm fl) by length separation (<56 cm fl) did not differ ($p>0.05$) from all measured jacks (Table 2).

Jacks did not differ ($p>0.05$) in size from jacks of the 1987 and 1988 seasons, but were smaller than jacks from the 1985 season, and larger than the 1985 season. Adults were comparable in size to last years adults ($p>0.05$), were larger ($p<0.05$) than adults of 1986-87, but smaller than 1985 adults. These size differences among seasons may be influenced by relative abundance of certain stocks, offshore harvest, and chinook in-river migration behavior and timing. Oceanic conditions vary yearly, and significant events such as the 1983 el Nino affected several brood years (see Annual Reports, 1984-1985). Ocean harvest levels, area closures, and length of fishing seasons would also influence the degree of impacts on adult stocks.

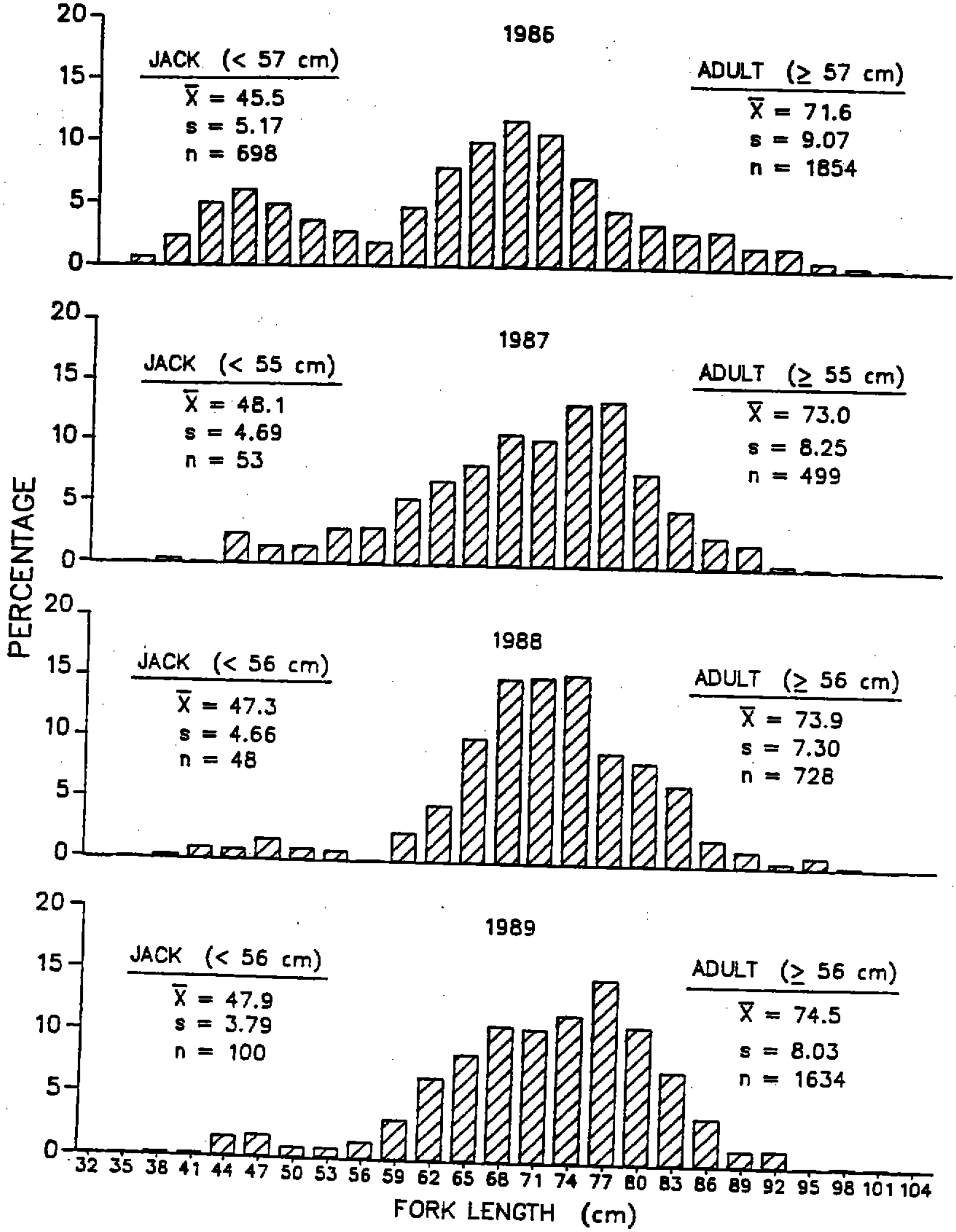

FIGURE 3. Length frequency distributions of chinook salmon captured during beach seining operations in the Klamath River estuary, 1986-1989.

TABLE 2. Mean length ($\bar{X}$), standard deviation (s) and sample size (n) of chinook captured in the 1989 beach seine operation. Comparisons of ad-clips and hook scarred categories by length, and by age.

	By Fork Length			By Age		
	$\bar{X}$	s	n	$\bar{X}$	s	n
AGED SAMPLE						
Jacks	49.8	4.65	45	48.7	3.65	44
Adults	74.4	8.08	896	74.4	8.05	901
ALL MEASURED						
Jacks	47.9	3.79	100			
Adults	74.5	8.03	1634			
NON-CLIPPED						
Jacks	47.9	3.81	99			
Adults	74.4	8.06	1510			
Age 2				49.8	4.65	45
Age 3				67.6	5.37	347
Age 4				78.8	5.80	449
Age 5				85.6	6.14	27
Age 6				85.0	-	1
Adults				74.3	8.10	824
AD-CLIPPED						
Jacks	47.0	-	1			
Adults	75.4	7.61	123			
Age 2				-	-	0
Age 3				66.9	4.64	16
Age 4				78.2	6.50	53
Age 5				84.0	2.00	3
Adults				75.9	7.76	72

TABLE 2. (Continued)
Mean length ($\overline{X}$), standard deviation (s) and sample size (n) of chinook captured in the 1989 beach seine operation. Comparisons of ad-clips and hook-scarred categories by length, and by age.

	By Fork Length			By Age		
	$\overline{X}$	s	n	$\overline{X}$	s	n
NON AD-CLIPPED						
Jacks	47.9	3.80	94			
Adults	74.6	8.09	1404			
Age 2				49.7	4.73	43
Age 3				67.7	5.33	303
Age 4				78.9	5.93	427
Age 5				84.9	5.93	27
Age 6				85.0	-	1
Adults				74.3	8.10	824
HOOK-SCARRED						
Jacks	48.0	4.05	6			
Adults	73.9	7.64	230			
Age 2				51.5	2.12	2
Age 3				67.3	5.41	60
Age 4				77.8	5.49	75
Age 5				90.0	2.00	3
Adulcs				73.5	7.88	138

Adipose Fin-Clips

Adipose fin-clips (Ad-clip) were observed on 123 chinook adults, and one jack. The overall Ad-clip rate was 7.2%, while the Ad-clip rates for jacks and adults was 1.0%, and 7.5%, respectively. Adipose fin-clip adults averaged 75.4 cm. The mean length of chinook not fin-clipped (non-clip) jacks and adults was 47.9 cm and 74.4 cm, respectively. The solitary Ad-clip jack precluded size comparison with non-clip jacks. The size of Ad-clip versus non-clip adults did not differ ($p>0.05$) statistically. Comparable analyses by age using the bio-sample data failed to show any significant differences or trends (Table 2, and see AGE COMPOSITION section).

Adipose fin-clipped adults have been smaller than non-clip adults in five of the eight previous seasons (1981-82, 1984-85, and 1987); with no differences in the 1983, 1986, and 1988 seasons. Differences in size of Ad-clip versus non-clip adults in past seasons were attributed to reduction in growth from the fin-clipping process. However, these differences have not been consistent and why growth was affected in some years and not in others is unknown. Also, these growth comparisons may have limited utility, since CWT chinook may represent composite stocks and specific stocks cannot be segregated to permit meaningful comparisons without sacrificing (CWT removal) the Ad-clip chinook. The relative abundance of certain Ad-clip stocks could also affect these size comparisons (e.g. size at release, and genetic characteristic of age at maturity).

The weekly Ad-clip rates varied from no Ad-clips to 10.8%. During the first three sampling weeks (7/17/89 to 8/4/89), only one Ad-clip chinook was captured among 90 adult chinook. The Ad-clip rate for this interval was 1.1%. After this period, the rate went up to 10.8% in the fourth week, and thereafter, varied from a low of 3.0% to 9.5%, with no apparent trends. This season contrasts with results observed last season. The Ad-clip rate for the first three weeks was 16.4%, 6.3%, and 0%, respectively. Then the Ad-clip rate increased from 6.0% to 21.0% over the following seven weeks. A similar trend was also noted for the 1987 season. No other types of fin-clips (ventral, pectoral, or caudal fins) were observed on chinook salmon.

Hook-Scarring

Of 1,734 chinook examined (100 jacks and 1,634 adults), 6 jacks and 230 adults were hook-scarred, for categorical occurrence rates of 6.0%, and 14.1%, respectively, and 13.6% overall. The hook-scarred jacks exhibited 6 single scars only, while 12 of the 230 scarred adults had two scars, for a total of 242 scars on adult chinook (Table 3). Percentage comparisons in Table 3 are based on a total of 248 individual scars, which have been further divided into "fresh", and "healed" categories, severity ratings, and by specific locations.

Hook scars were most commonly seen on the upper jaw (55.2% of all scars), followed by the lower jaw (31.9%). Scars on other location categories ranged from 2.9% to 3.6%. As in previous seasons, the upper and lower jaw continue to receive the majority of hook scars. Healed scars were more common (56.4%) than fresh scars (43.6%). Healed scars have been more prevalent in three of the past four seasons (1987, 1986, and 1985).

TABLE 3. Hook scars observed on 6 chinook jacks and 230 adults during the 1989 beach seining operation. Hook scars are categorized by type (fresh or healed), severity (Min = minor, Mod = moderate, Maj = major), category (single or double), and location.

		Fresh				Healed				
		Min	Mod	Maj	Fresh Total	Min	Mod	Maj	Healed Total	Grand Total
Run Component	Jack (N= 6)	1	1	0	2	2	1	1	4	6
	Adult (N=230)	78	25	3	106	86	40	10	136	242
	Total	79	26	3	108	88	41	11	140	248
Category	Single (N=236)	77	25	3	105	85	39	7	131	236
	Double (N= 12)	2	1	0	3	3	2	4	9	12
	Total	79	26	3	108	88	41	11	140	248
Location	Upper jaw	51	13	1	65	48	19	5	72	137
	Lower jaw	28	10	0	38	25	14	2	41	79
	Eye & Proximity	0	0	1	1	4	3	0	7	8
	Opercle	0	0	0	0	6	3	0	9	9
	Isthmus	0	0	0	0	2	1	4	7	7
	Other areas	0	3	1	4	3	1	0	4	8
	Total	79	26	3	108	88	41	11	140	248

The 1989 hook scar occurrence rate was comparable to the 1988 season, and these two years constitute the lowest rates since 1985 (Figure 4). The hook scar rate appears to be related to the ocean harvest levels, as displayed by their relationship for the 1980-1989 seasons (Figure 5). Within this relationship, various factors could influence the hook scar rate. Chinook differ in their age at maturity, and a longer ocean residence may increase the possibility of sustaining hook scars. The distribution of chinook offshore is not constant; and sport and commercial fishing regulations (quotas, time and spatial closures) have varied yearly.

The mean fork length of scarred jacks was 48.0 cm, and 73.9 cm for adults. In comparison, non-scarred jacks and adults averaged 47.9 cm, and 74.6 cm, respectively. The size of jacks and adults between both categories did not differ ($p>0.05$) in lengths. Similar comparisons by age did not reveal any apparent trends. To determine if the hook-scar rate differed by size, adult chinook were divided into groups of ten centimeter fork length intervals. The scar rate was uniform (range: 14.2% to 14.6%) from 56 cm to 89 cm, and decreased to 6.5% for chinook 90 cm and larger. The decrease may reflect the size selectivity of hook and line gear or may be a function of the smaller sample size of the larger size groups.

As in most prior seasons (1980-1981, 1983-1984, and 1987-1988), hook-scarred and non-scarred adults did not differ in size, while the hook-scarred adults were smaller in 1979, 1982, and 1986. In 1985, hook-scarred adults were larger; pre-el Nino 4- and 5-year-old hook-scarred adults inflated their mean lengths (refer to 1985 Annual Report, el Nino section). However, explanations for why growth is affected in some years and not in other years are unknown.

Length-Weight Relationship

Weights were recorded from 503 chinook, consisting of 38 jacks and 465 adults; their mean weights were 1.9 kg, and 6.5 kg, respectively (Figure 6). The smallest chinook weighed 0.9 kg, the heaviest was 17.7 kg. The mean length of jacks and adults from this weight sub-sample was 47.8 cm and 74.9 cm, respectively. These mean lengths (503 chinook sub-sample) did not differ significantly ($p>0.05$) from the main sample of 100 jacks and 1,634 adults measured. Therefore the results of the length-weight analyses are assumed to be representative of the entire catch sample. The formula describing the length-weight relationship was described by the equation:

$$\text{Weight (kg)} = 10^{(-4.436 + 2.793 (\text{Log (fork length)}))} \qquad r^2 = 0.98$$

Gill Net Markings and Predator Marks

Gill net marks were seen on 25 adult chinook, for an 1.4% incidence rate. These fish averaged 75.5 cm fork length, and did not differ ($p>0.05$) in length from all measured adults. The incidence rates for the 1986 through 1988 seasons were: 1.3%, 2.2%, and 0.3%, respectively.

In previous reports, the gill net marking incidence has been implicated to the intensity of the estuary gill net fishery. However, during the 1988 season,

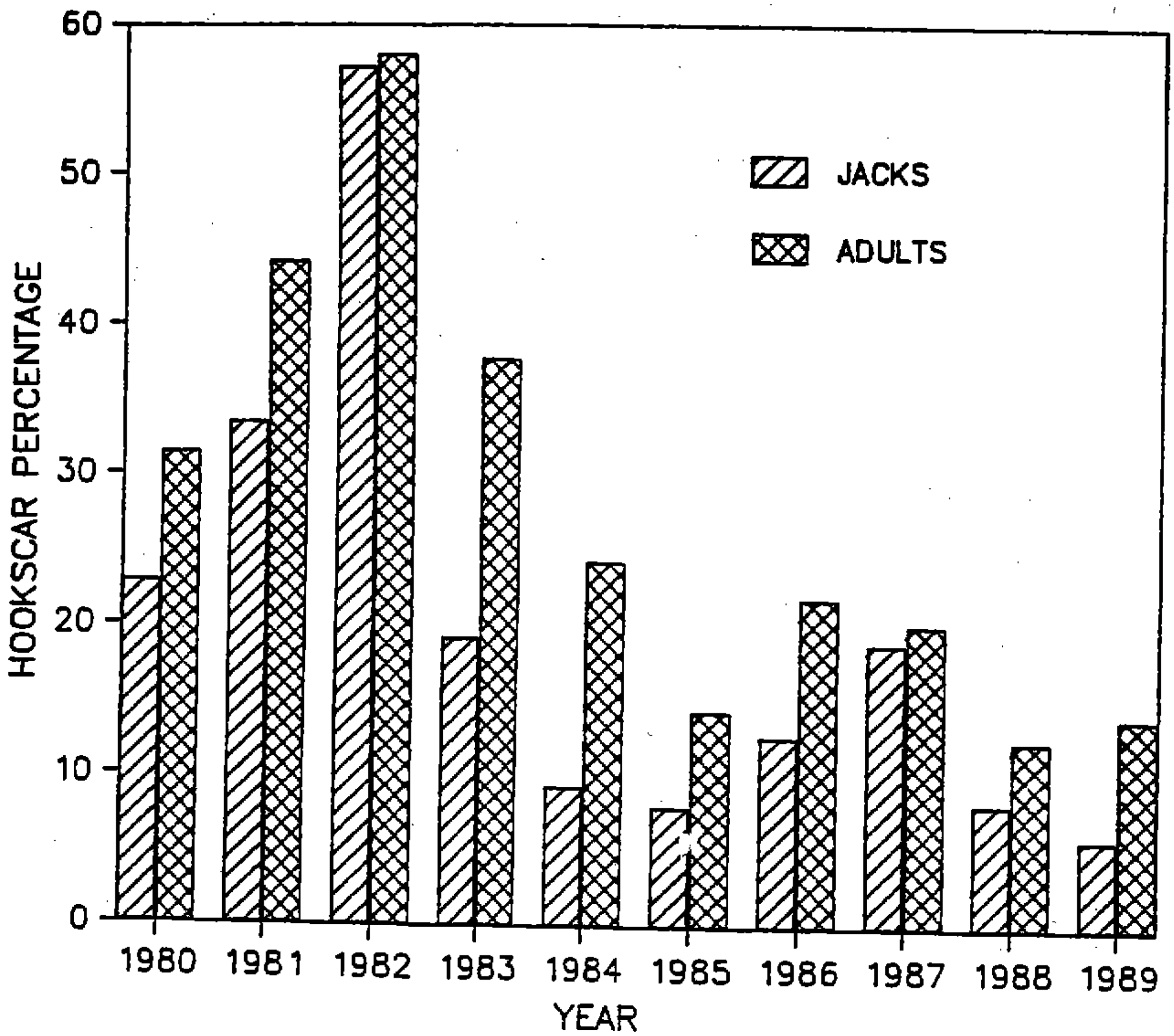

FIGURE 4. Hook scarring rates observed on jack and adult chinook salmon during 1980-1989 beach seining operations in the Klamath River estuary.

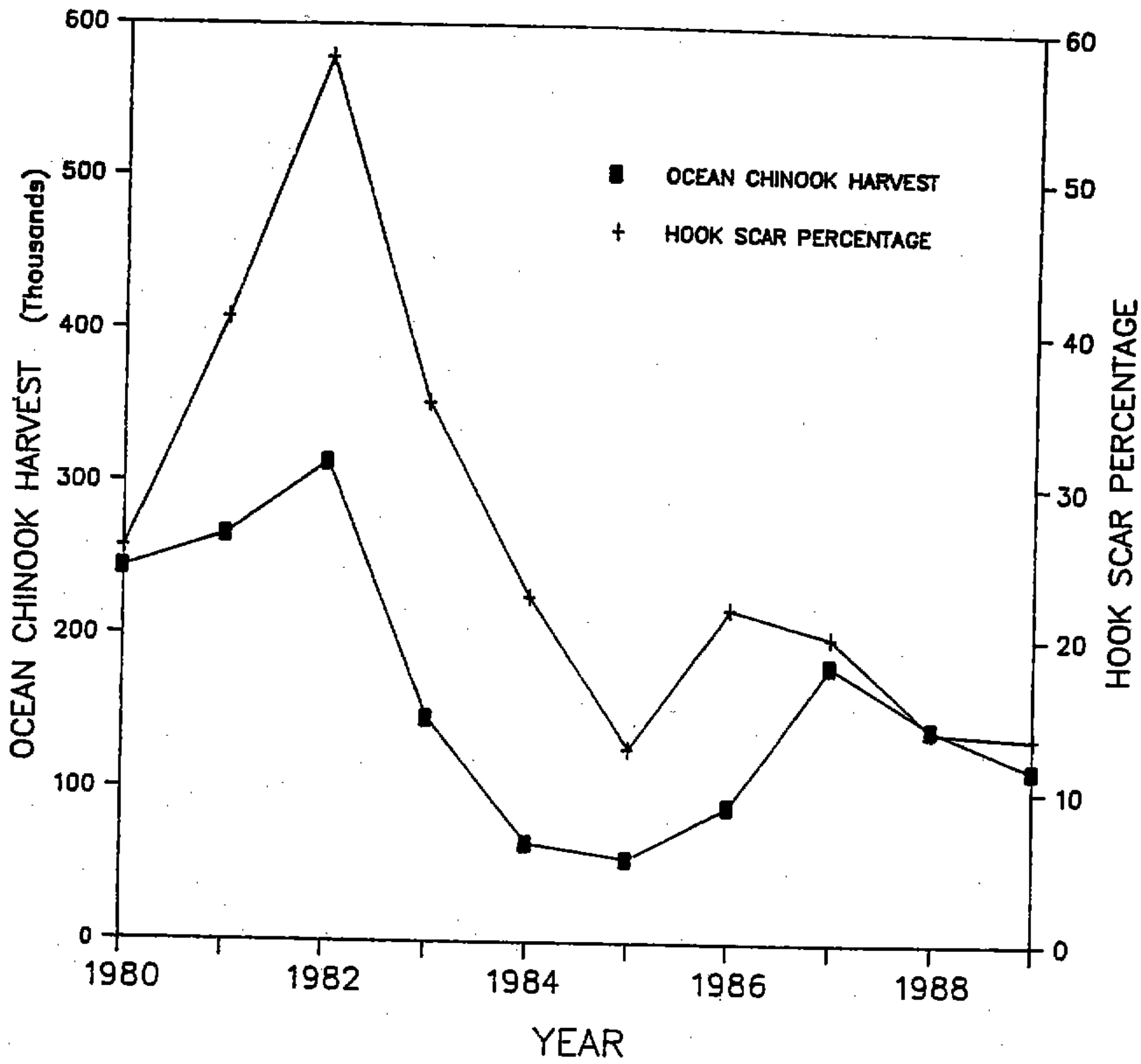

FIGURE 5. Overall chinook hook scar percentage observed in the beach seining project (1980-1989) and ocean harvest (troll and sport fishery landings) of chinook salmon. Ocean harvest levels are for the Klamath Management Zone (1986-1989) and combined port landings for Eureka, CA, Crescent City, CA, and Brookings, OR (1980-1985).

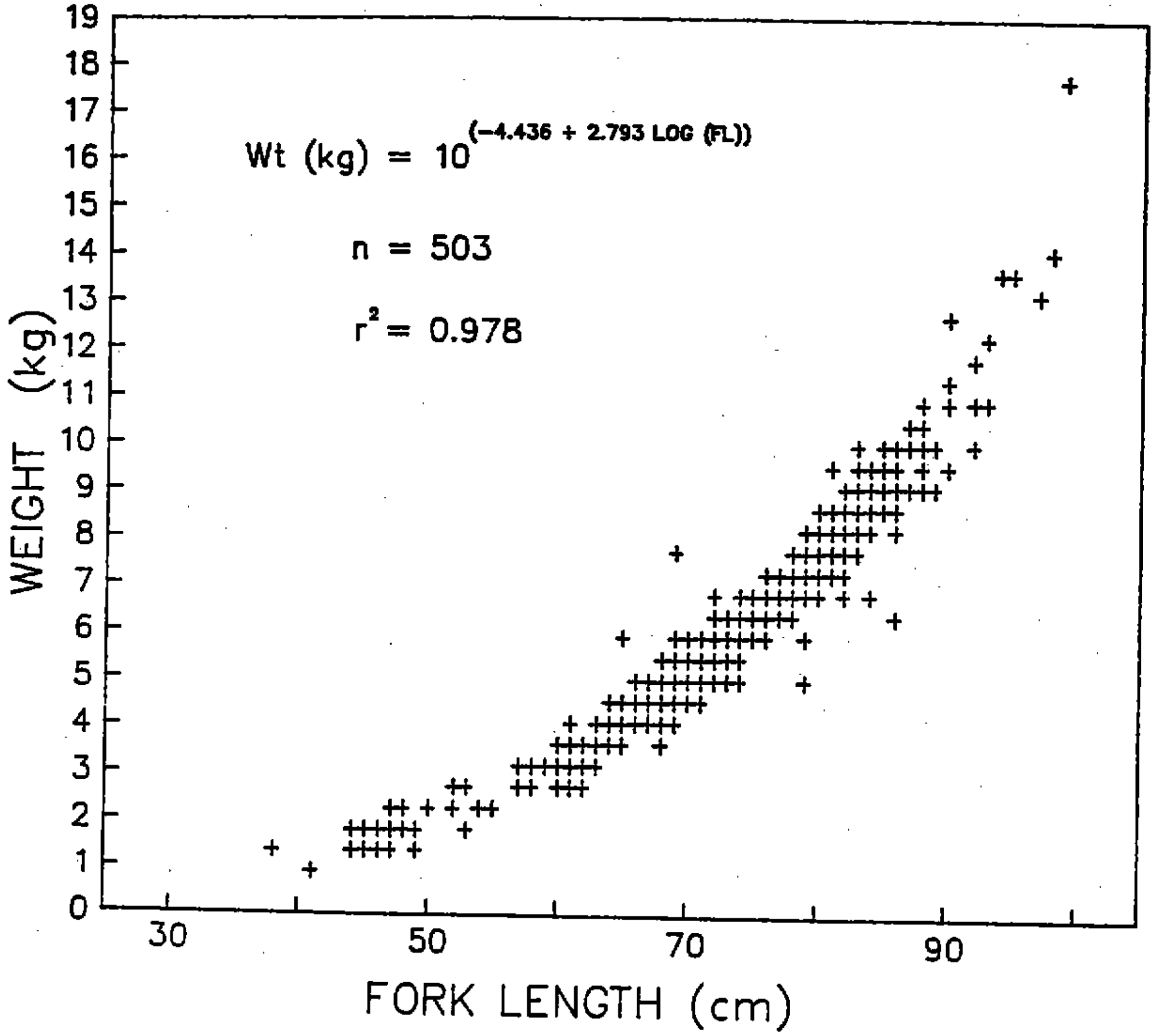

FIGURE 6. Length-weight relationship of chinook salmon captured during 1989 beach seining operations in the Klamath River estuary.

the marking rate was 0.3% despite an intensive estuary gill net fishery. The 1989 incidence rate is much higher although the level of gill netting effort was only slightly higher than observed in 1988 (refer to NET HARVEST section). Many complex factors may be responsible for the observed variation, and may not be attributable solely to the intensity of the gill net effort. Drop-out rates could be affected by the mesh size, morphology of the chinook, and how the fisher attends the net. Chinook escaping from a gill net may have impaired ability to avoid predation, and other gill nets. These fish may also succumb to post-escape mortality as a result of induced stress. These factors would theoretically reduce the number of escaped chinook that would otherwise be susceptible to capture in the beach seine.

Predator marks or wounds were found on 36 chinook (1 jack, 35 adults), for a 2.1% incidence rate. The markings and wounds are believed to be from encounters primarily with harbor seals (Zalophus californianus), and California sea lions (Phoca vitulina), although a few wounds from lamprey (Lampetra spp.) were also noted. The afflicted chinook averaged 73.9 cm in length, and 74.5 cm for adults. The 1988 predator marking rate was 2.4%.

Catch/Effort and Run Timing

The 1989 fall chinook run timing pattern is displayed by the catch per unit effort (C/E) graph (Figure 7). Catch per unit effort also allows standardization and comparisons of daily total catch when the level of effort is not constant. Catch per unit effort has been influenced by variable factors such as seining site location, time and tidal stage, river mouth morphology, and run timing, and has not allowed reliable comparisons of C/E between seasons. Therefore, the C/E discussion is limited only to the 1989 season. The C/E run timing patterns from previous seasons are presented in Figure 7 for information only.

Analyses of weekly C/E for the season by time of seining did not reveal any catch trends. By tidal stage, the lowest weekly C/E was associated with the high slack stage, whereas C/E varied with other tidal stages. The highest weekly mean C/E by time period occurred during mid-day (1001-1200 hrs), although C/E by time period was highly variable throughout the season. As noted in prior seasons, catch success continues to be a function of run timing.

For the 1989 season, the highest mean C/E by time period and tidal stage was 7.5 (mid-day) and 11.8 (low slack), respectively. The season C/E was 6.6 (mean chinook per seine haul).

Mark-Recapture and Migration

The FWS seining project applied spaghetti tags to 629 chinook, which consisted of 2 jacks and 627 adults. The mean length of all tagged adults (75.1 cm) did not differ ($p>0.05$) statistically from all measured adults (74.5 cm). The following analyses applies only to chinook that were tagged by FWS, and does not reflect those applied by CDFG. Recapture days at large are inclusive.

A total of 131 tags were returned, for a return rate of 20.8%, which is less than observed for the 1988 (27.1%) and 1987 (28.2%) seasons. This lower rate may be related to the 629 tags applied, the fewest tags applied since 1983.

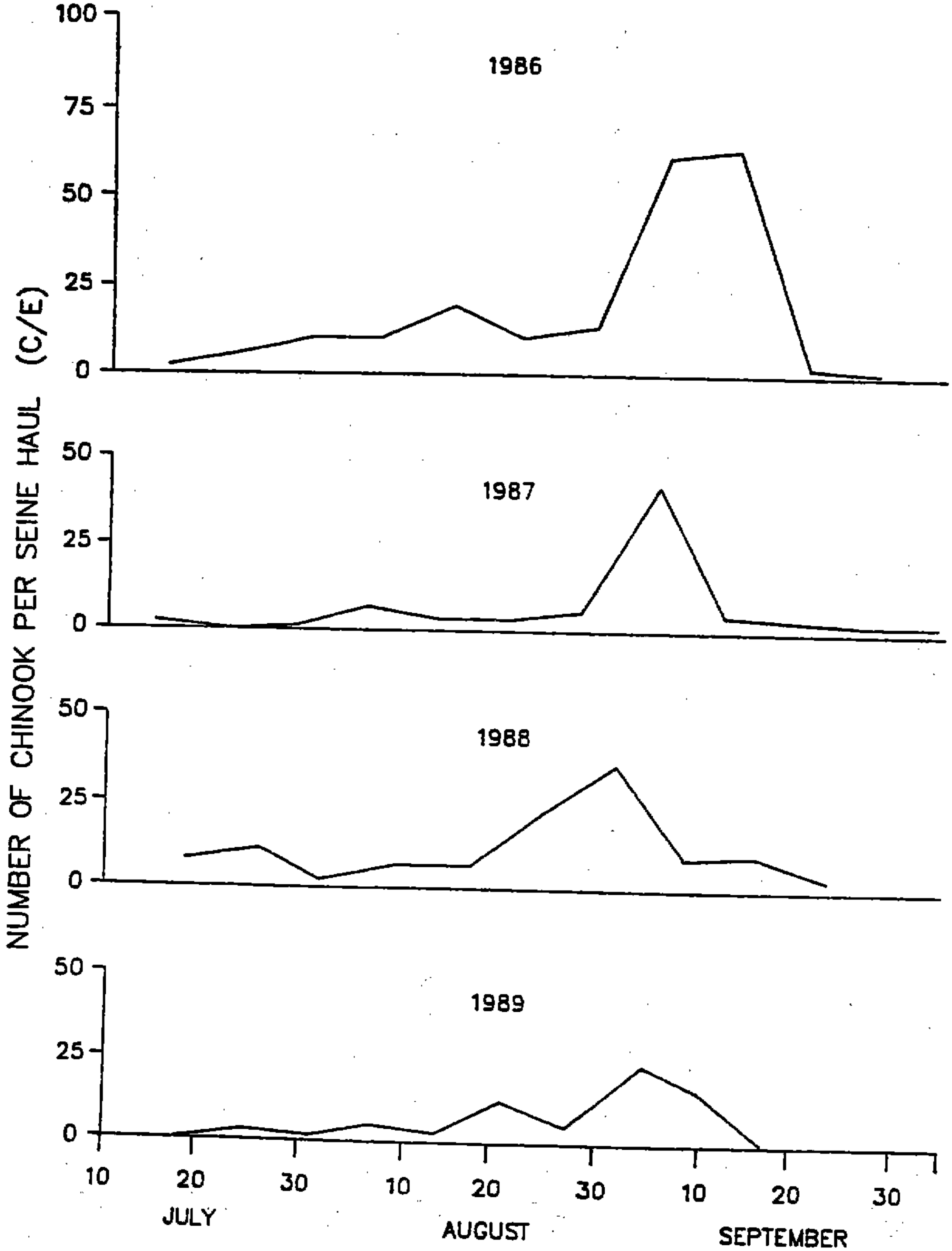

FIGURE 7. Weekly averages of the number of chinook salmon captured per seine haul in the Klamath River estuary during the 1986-1989 beach seining operations.

The majority of the returns (29) came from IGH, followed by the Indian gill net fishery (23) and sport angler harvest (23), spawning ground surveys (19), and TRH (16). The remaining returns are categorized in Table 4. For the 1988 season, the most tag returns were from TRH (36), gill net fishery (30), Bogus Creek weir (28), and in-river sport fishery (23).

The mean length of tagged chinook recovered from the gill net fishery was 78.0 cm, whereas the angler return of tagged chinook averaged 71.8 cm. Chinook tag returns from IGH averaged 75.2 cm, and tagged chinook returning to TRH averaged 69.6 cm. This size difference would not be unusual, since TRH stocks are known to mature at an earlier age than IGH stocks.

Of 131 tags returned, 90 had sufficient information to compute migration timing. The mean Julian date (J.D.) of tagging for the IGH tag returns was 244, while the mean J.D. of recapture was 296. For TRH, the mean tagging J.D. was 250, and the mean J.D. of recapture was 296. The mean migration rate for tagged returns from IGH was 7.1 km/day, and 3.9 km/day for TRH tagged returns. For tagged chinook recovered at IGH, individuals tagged later in the seining season tended to migrate faster than those tagged earlier. This tendency was not observed for the TRH recoveries, although the TRH stocks exhibited this tendency in 1988. The results from this and prior seasons continue to reflect the known differences in run-timing characteristics between these two stocks.

In 1988, the mean J.D. of tagging for TRH chinook was 233, 287 for the mean recovery J.D., and mean migration rate was 4.9 km/day. IGH data for 1988 was not available, but for the 1987 season, the values were J.D. 248, J.D. 290, and 4.3 km/day, respectively.

The FWS seining operation recaptured 14 chinook, of which five were spaghetti-tagged, and nine were caudal hole-punched. Three of these tagged chinook were same-day recaptures, one was at large for 10 days, and one was tagged 18 days earlier.

One tagged chinook was recaptured at the Bogus Creek weir, compared to 28 that were recovered in 1988. This difference may be related to the smaller run return to IGH (11,690) during 1989, while the 1988 return was 16,715.

TABLE 4. Recovery data from fall chinook salmon tagged by the Fish and Wildlife Service on the Klamath River during 1982-1989 beach seining operations.

Recovery Source 1/	NUMBER RECOVERED								Totals
	1982	1983	1984	1985	1986	1987	1988	1989	1979-89
USFWS Beach Seine	14	7	20	3	28	9	10	14	227
CDFG Beach Seine	3	-	12	5	7	4	0	0	46
Gill Net Fishery	46	14	31	35	8	45	30	23	357
Shasta River Weir	19	0	3	3	1	7	0	0	104
In-River Sport Fishery	13	11	7	23	13	79	23	23	249
Trinity River Hatchery	16	14	20	72	34	44	36	16	302
Iron Gate Hatchery	20	12	14	85	30	58	18	29	303
Bogus Creek Weir	22	1	8	21	4	48	28	1	133
Willow Creek Weir	8	4	11	22	8	6	3	1	74
Scott River Weir	8	2	2	4	2	6	2	2	28
Junction City Weir	0	-	4	3	2	0	5	0	16
S.F. Trinity River Weir	-	-	1	1	0	2	0	0	4
N.F. Trinity River Weir	1	0	0	-	-	0	-	-	1
Salmon River Weir	-	-	-	4	0	0	3	0	7
Ocean	0	0	1	0	0	0	0	0	2
Spawning Ground Surveys	1	0	4	5	3	8	0	3	56
Unknown	8	4	1	13	7	0	47	19	53
Total Recovered	179	69	139	332	147	316	205	131	2,008
Number Tagged	1,018	588	1,007	1,746	1,475	1,119	757	629	12,470
Recovery Rate	0.176	0.117	0.138	0.190	0.099	0.282	0.271	0.208	0.161

1/ Listed weirs were not in operation during years where no recovery number is presented.

AGE COMPOSITION

INTRODUCTION

Information on the age composition of fish stocks is invaluable to effective fishery resource management. Age data, in combination with length and weight measurements, can provide information on stock composition, age at maturity, growth, and production. Such information is useful in developing management goals and regulations prior to harvest seasons, and in monitoring the results and effectiveness of fishery management practices. In a continuing program to evaluate the age composition of fall chinook salmon runs in the Klamath River Basin, scales were collected during the 1989 beach seining program. A summary of age information from fall chinook runs of past seasons is also included.

METHODS

Field Methods

The age composition for the 1989 fall chinook run was determined through scale analyses. Scales were taken from chinook collected near the mouth of the Klamath River during the beach seining operation. The seining project operated between July 17 and September 22, 1989 (refer to BEACH SEINING section for details).

Laboratory Methods

A total of 1,722 scale samples were collected in 304 seine hauls; nearly every chinook was sampled, except in five hauls where scale samples were taken from every other chinook. To compensate for these five hauls, every other scale sample was chosen for analysis from the 299 other hauls. This method of selection yielded 945 samples available for analyses. The selected scale samples are proportional (1:2 ratio) to the daily total catch, and therefore assumed to be unbiased.

Scales were cleaned, and impressions were made on cellulose acetate using a hydraulic press equipped with heating elements. The scale impressions were viewed on a microfiche reader. The impressions were analyzed independently by two readers, and any differences between analyses were reviewed with a third reader. Scales not aged confidently after the final reading were excluded from the age analyses. Scales from known age, coded-wire-tagged (CWT) chinook recovered from the Klamath River estuary were initially used to assist in the age interpretation.

RESULTS AND DISCUSSION

From 945 selected scale samples, 941 were read with confidence, and constitute the final 1989 fall chinook age sample. Four-year-old chinook comprised 53.3% of the catch, followed by three-year-olds (38.6%), two-year-olds (4.8%), and five-year-olds (3.2%). Six-year-olds represented 0.1% of the catch (Table 5). In contrast with age compositions from all prior seasons (1979-1988), the percentage of jacks was the smallest, and four-year-olds were the largest. Percentage of five-year-olds was surpassed only by the 1985 season (6.5%). The percentage of three-year-olds fell within the range observed from past seasons.

Division of the age data into four consecutive and equal time strata revealed significant differences ($p<0.05$, Pearson's chi-square) in run timing by age class (Table 6). The percentage of jacks and three-year-olds increased over the course of the season, while four- and five-year-olds decreased. Despite the decrease in percentage of four-year-olds, they dominated during the majority of the season. The earlier entry of older fish followed by the entry of relatively younger fish are consistent with findings of most prior seasons, except 1987 when the early entry of four-year-olds was not apparent. The late-season increase of two- and three-year-olds is believed to represent the later-running Trinity River stocks which are also known to mature at an earlier age.

The two-year-old chinook age class was significantly ($p<0.05$) larger than their counterparts from 1988 and 1986, but did not differ from two-year-olds from 1987 and 1985. These findings differ slightly from the length-frequency comparisons presented in the BEACH SEINING results section of this report. Differences occur because the length-frequency results presented in the BEACH SEINING section represent (in most seasons) all of the chinook measured. The sampling rate (relative to the entire catch) however, has not always been consistent or comparable among seasons. Therefore, the number of scale samples used in determining the age composition for this (and prior seasons) reports has been adjusted to compensate for any uneven or non-representative sampling that occurred in the field. The length and age statistics presented in this age composition section are believed to be an unbiased estimate of the fall chinook population.

Three-year-old chinook were smaller than the three-year-old chinook from the 1988 and 1985 seasons, and did not differ ($p>0.05$) from the 1987-1986 seasons. Four-year-olds were similar in size with 1988 four-year-olds, larger than 1987 four-year-olds, but smaller than the 1985 and 1986 four-year-olds. Five-year-olds did not differ in size with their counterparts from 1985, 1987, and 1988, but were smaller than five-year-olds from 1986.

The FWS beach seining program has provided age composition estimates of the fall chinook. The combined numbers generated from FWS age composition and CDFG in-river run size estimates are presented by each age class group (Table 7). This information has allowed comparison of cohort groups by brood year cycles. These combined age and cohort data has assisted management biologists in the estimation of the ocean abundance of 3- and 4-year-old Klamath River fall chinook. The age and cohort estimates presented in Table 7 were made for comparative purposes only and are not intended to supplant the run size estimates generated by the CDFG.

TABLE 5. Percentage age composition, mean length ($\bar{X}$), standard deviation (s) and sample size (n) of Klamath River fall chinook captured during the 1981-1989 return years.

Return Year		AGE AT RETURN			
		2	3	4	5 1/
1981	% Age Comp	32.9	53.6	12.0	1.5
	$\bar{X}$	50.2	68.1	80.5	89.0
	s	4.95	6.85	6.09	5.95
	n	176	287	64	8
1982	% Age Comp	29.1	32.0	36.1	2.3
	$\bar{X}$	48.3	69.3	83.2	87.2
	s	4.25	6.51	7.02	7.48
	n	161	177	200	13
1983	% Age Comp	12.9	54.3	31.4	1.4
	$\bar{X}$	41.9	60.3	71.5	82.2
	s	3.73	4.82	6.07	6.77
	n	80	338	195	9
1984	% Age Comp	13.0	40.0	45.0	2.0
	$\bar{X}$	45.4	62.9	72.6	81.1
	s	3.89	3.96	4.78	7.89
	n	123	379	426	19
1985	% Age Comp	25.7	38.0	29.6	6.5
	$\bar{X}$	51.0	70.5	81.0	84.7
	s	4.99	4.23	5.60	5.32
	n	126	186	145	32
1986	% Age Comp	22.9	64.4	11.8	0.9
	$\bar{X}$	46.6	66.9	83.9	92.7
	s	5.37	5.71	6.87	5.06
	n	169	475	87	7
1987	% Age Comp	10.5	38.4	48.2	2.5
	$\bar{X}$	49.0	66.9	77.6	82.2
	s	5.38	5.75	5.85	5.63
	n	58	212	266	14
1988	% Age Comp	6.1	49.6	42.4	1.9
	$\bar{X}$	47.3	69.6	78.3	85.1
	s	4.93	5.17	6.27	7.69
	n	47	384	328	15
1989	% Age Comp	4.8	38.6	53.3	3.3
	$\bar{X}$	49.8	67.6	78.7	85.4
	s	4.65	5.34	5.88	5.85
	n	45	363	502	31

1/ Also includes 6-year-olds in 1988-89. X = mean fork length in cm, s = standard deviation of forklength and n = sample size.

TABLE 6. Age class contribution of fall chinook salmon during four equal time intervals from the 1989 Klamath River beach seine sample as determined through scale analysis. (n=sample size, $\overline{X}$=sample mean, s=standard deviation).

Age		RUN TIMING 7/17 - 8/2	8/3 - 8/19	8/20 - 9/5	9/6 - 9/22	Total
2	n	0 (0.0%)	0 (0.0%)	11 (3.1%)	34 (8.0%)	45 (9.7%)
	$\overline{X}$			49.3	49.9	
	s			4.38	4.78	
3	n	4 (18.2%)	34 (24.6%)	114 (32.0%)	211 (49.7%)	363 (38.6%)
	$\overline{X}$	66.5	70.3	68.1	66.9	
	s	1.29	5.57	5.75	5.00	
4	n	15 (68.2%)	96 (69.6%)	219 (61.5%)	172 (40.5%)	502 (53.4%)
	$\overline{X}$	79.3	79.0	79.1	77.9	
	s	4.79	4.80	5.99	6.31	
5	n	2 (9.1%)	8 (5.8%)	12 (3.4%)	8 (1.9%)	30 (3.2%)
	$\overline{X}$	82.5	86.5	83.7	87.6	
	s	0.71	4.75	5.85	7.13	
6	n	1 (4.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.1%)
	$\overline{X}$	85.0				
	s	-				
Total	n	22	138	356	425	941

TABLE 7. Estimated number of fall chinook by age entering the Klamath River during the 1979-1989 return years.

Return Year	AGE 2	3	4	5 1/	Total
1979	8,867	20,197	28,695	3,818	61,577
1980	47,021	14,430	15,484	4,135	81,070
1981	34,567	56,315	12,608	1,576	105,066
1982	30,316	33,338	37,609	2,917	104,180
1983	7,817	32,905	19,028	849	60,599
1984	6,993	21,517	24,206	1,076	53,792
1985	34,023	50,306	39,186	8,870	132,385
1986	54,200	152,421	27,928	2,130	236,679
1987	23,416	85,634	107,489	6,467	223,006
1988	12,757	104,232	89,031	4,072	210,092 2/
1989	6,320	50,987	70,511	4,354	132,172
1979-1989 Average	24,209	56,571	42,889	3,660	127,329

1/ Also includes 6-year-olds

2/ Total number (and by age) for 1988 differ from estimates published in 1988 annual report due to a 1989 revision of CDFG's 1988 run size estimate.

The two-year-old age class is often used to assess the strength of the brood. In some years, the relative abundance of returning jacks (age 2) has been a good indicator of its brood year strength for the Klamath River stocks. This association was observed for the 1977 through 1981 brood years, and 1983 through 1985 brood years. Although the percentage and number of jacks in 1982 were less than the two previous (1979, 1980) brood years, the total contribution by 1982 brood year was similar to the 1979-1980 brood years. The 1983 through 1985 brood years have contributed the greatest return numbers since CCFRO, Arcata began monitoring the fall chinook runs. However, there is a trend of declining contributions over these years. The 1989 return of 50,987 three-year-olds (brood year 1986) strongly suggests that this brood may also follow the trend of the 1983-1985 brood years (Figure 8).

The 1989 age 2 year class percentage (4.8%) is the lowest observed since the seining program was initiated, and represents the third consecutive year of low jack percentages (Table 7). Based on the recent trend of brood year contributions and this season's low return of two- and three-year-olds, next season's in-river return to the Klamath River may be reduced considerably.

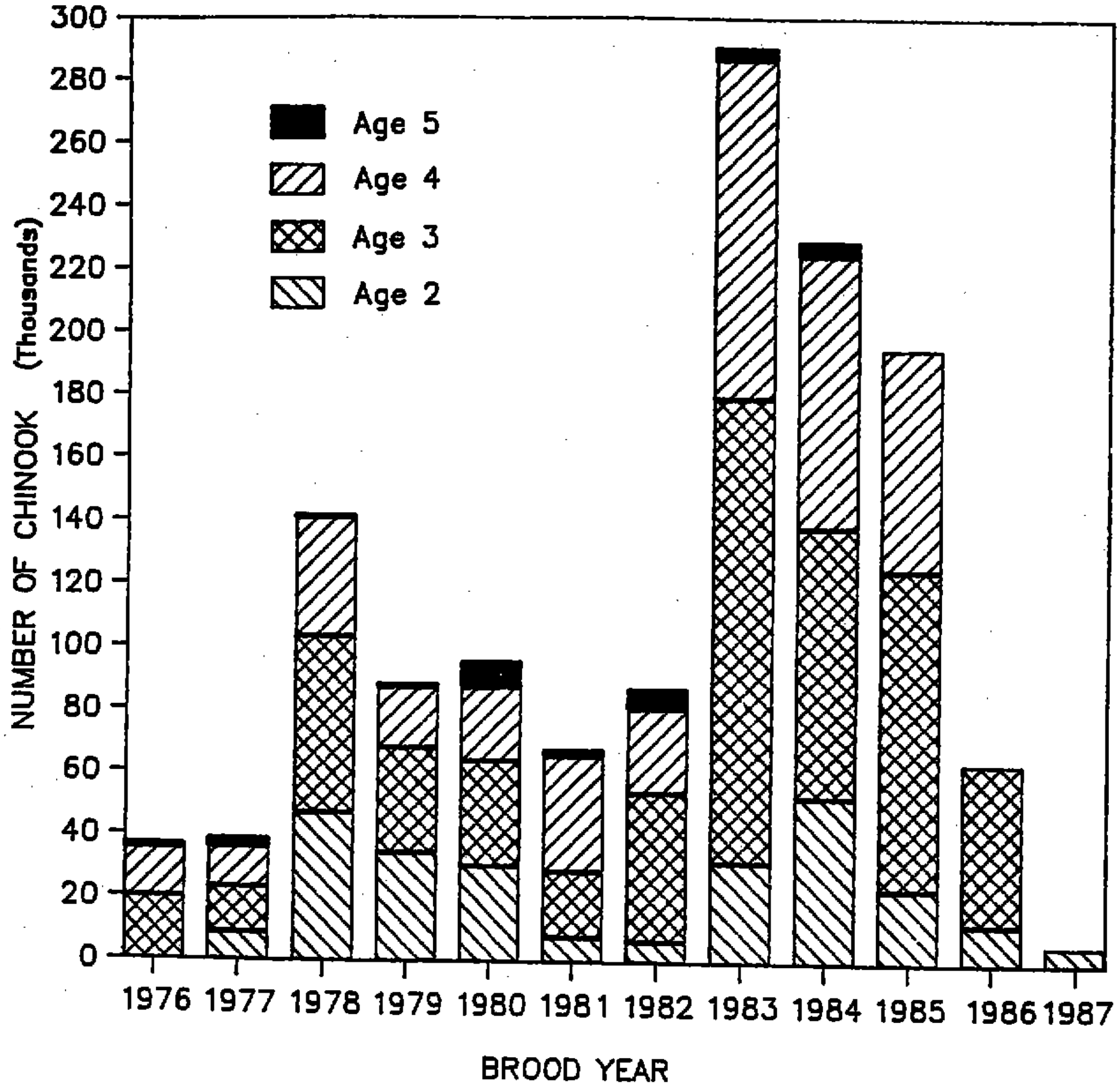

FIGURE 8. Brood year contributions, by age, of fall chinook salmon to 1979-1989 Klamath River returns.

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NET HARVEST MONITORING PROGRAM

INTRODUCTION

Hoopa, Karuk and Yurok Indian people living along the Klamath and Trinity Rivers have traditionally fished for salmon, steelhead, sturgeon and other species using a variety of fishing gear including weirs, dip nets, spears and gill nets. Historically, salmon consumption by these people exceeded 907,000 kg (2 million pounds) annually (Hoptowit 1980). For historical accounts of the Indian fisheries see Hoptowit (1980), Bearss (1981) and USFWS (1981).

Regulations governing recent Indian fishing on the Hoopa Valley Reservation (HVR) were first published by the DOI in 1977 and CCFRO, Arcata biologists began monitoring net harvest levels on the Reservation in 1978 (USFWS 1981). The initial effort was focused on fall chinook salmon. Further progress was made in ascertaining net harvest levels with the establishment of a net harvest monitoring station in the lower Klamath River in 1980. Net harvest monitoring operations were expanded up river beginning in 1981 for Reservation-wide coverage of the net fishery. Since 1983, CCFRO, Arcata biologists have focused monitoring efforts solely on the Klamath River portion of the HVR. In October 1988, Congressional action separated this area from the HVR and created the Yurok Indian Reservation (YIR). Responsibility for monitoring net harvest levels on the Trinity River within the HVR was taken over by the Hoopa Valley Business Council (HVBC) Fisheries Department in 1983.

Beginning in 1984, CCFRO, Arcata biologists employed a stratified random sampling methodology to assess fall season net harvest levels for chinook salmon, coho salmon, steelhead trout and sturgeon on the Klamath River portion of the HVR (now the YIR) in an attempt to improve the accuracy and gauge the precision of the harvest estimates. The techniques employed during former seasons yielded point estimates without associated measures of variance. Although they are considered reasonably reliable and accurate, no quantifiable measure of precision can be calculated for estimates made prior to 1984.

An allocation agrement between the various user groups of the Klamath River fall chinook resource (ocean commercial, ocean sport, river sport and Indian gill net) was signed in 1986 (Klamath River Salmon Long-Term Harvest Sharing Agreement). This allocation allowed harvest of the chinook resource and yet provided for the sustained runs of the chinook populations. Toward this goal, the DOI enacted regulations designed to allow for the harvest of the YIR quota of fall chinook, established by harvest rate management and the allocation agreement among the in-river users.

METHODS

Net harvest monitoring data were collected and compiled from three contiguous areas (Estuary, Middle Klamath and Upper Klamath) of the Klamath River on the YIR in 1989 (Figure 9). The Estuary Area (monitoring station near Klamath) was defined as the lower 6 km of the river from the mouth to the crossing of the U.S. Highway 101 bridge. The Middle Klamath Area (monitoring station near Omagar Creek) comprised the next 27 km of river from the crossing of the Highway 101 bridge to Surpur Creek, 33 km upstream from the mouth. The Upper Klamath Area

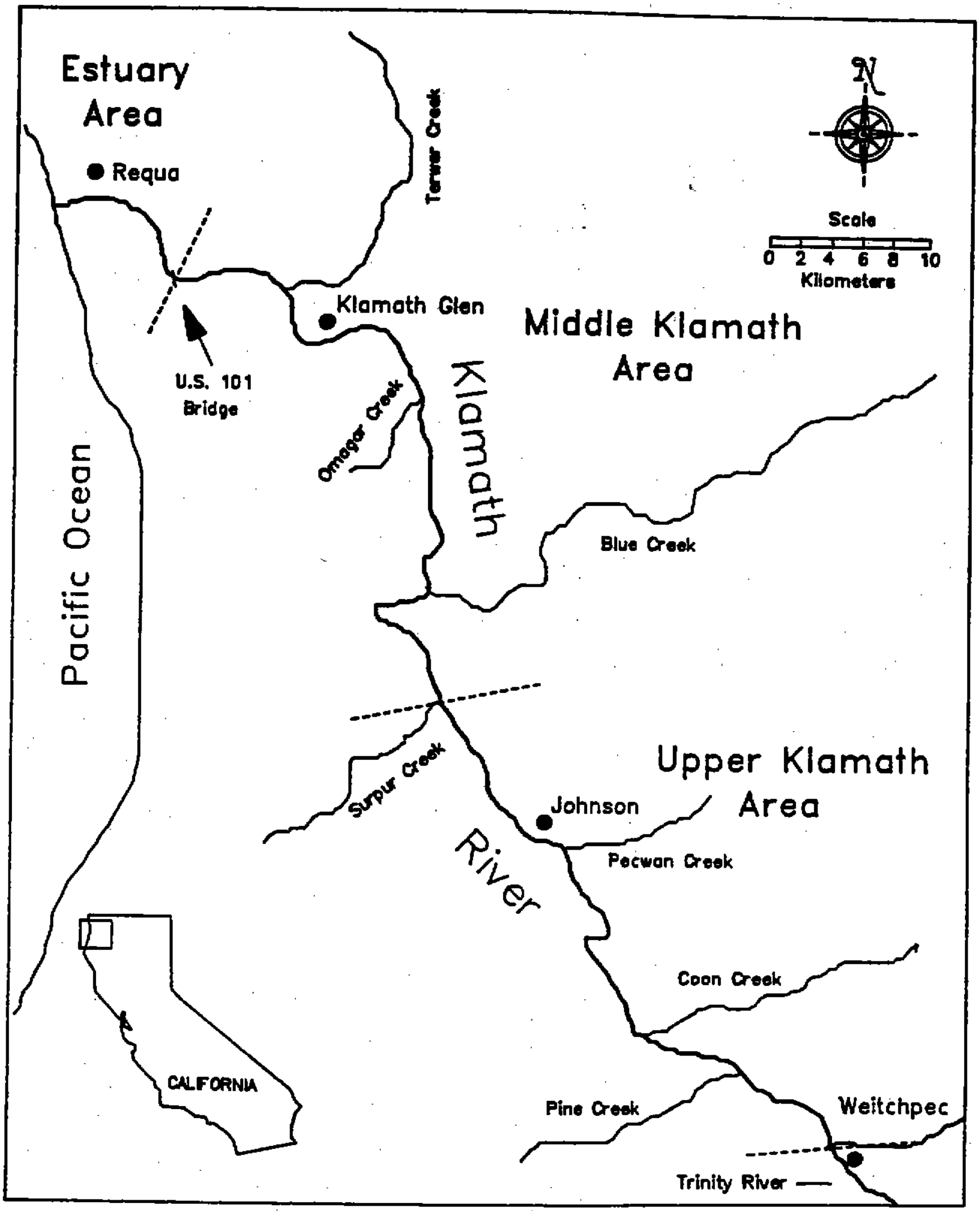

FIGURE 9. Net harvest monitoring areas for the Yurok Indian Reservation in 1989.

(monitoring station near Johnsons) included the next 37 km stretch of river from Surpur Creek to Weitchpec. During the 1989 fall chinook fishery, DOI regulations divided the reservation into three management zones that differ from the above areas. Area I included the portion of Klamath River from the mouth to the U.S. Highway 101 bridge (RKM 6). Area II began at the crossing of the U.S. Highway 101 bridge and continued upriver to the confluence of the Trinity River (RKM 70). Areas I and II were entirely within the YIR. Area III consisted of the Trinity River within the HVR. These zones were designed to allow equitable distribution of harvest throughout the two reservations. CCFRO, Arcata biologists monitored the harvest in Management Areas I and II, while the HVBC was responsible for estimating the harvest in Management Area III. In order to keep the data as comparable to previous years as possible, data in this report will be analyzed with regard to the three monitoring areas utilized in previous years.

Fall Fishery

The design employed by CCFRO, Arcata biologists to estimate harvest in 1989 involved a stratified random sampling technique with an optimum allocation of sampling effort based on the available data and associated variances. The estimate is comprised of two parts: an estimate or count of total effort and an estimate of average catch per net for each area and net type. Each part of the estimate has an associated variance estimate. These variances are combined to give an estimated daily variance. The daily estimates of catch and variance are expanded to total estimates of catch and variance by area, net type and time period, usually weekly. Following are the methodologies utilized for monitoring fall chinook harvest in each area and for subsequent data analyses.

Estuary Area

Under pre-season DOI regulations, the Estuary (DOI Management Area I) was open to gill net fishing from Monday at 1700 to the following Monday at 0900, until July 31, after which the Estuary was open to gill net fishing from 1900 Tuesday to 0900 Monday until August 7. The Estuary Area was closed from 0900 Monday, August 7 to 1900 Wednesday, August 9. The fall commercial fishery began on August 9. The Estuary Area was open to gill net fishing from 1900 to 0700 Wednesday through Sunday. The Estuary Area was closed September 3, after the attainment of its commercial and subsistence harvest quotas. The Estuary Area was monitored every day it was open from July 16 to September 3, by at least one field crew composed of one biologist and one Indian Technician.

Beginning July 25, total net counts were conducted every two hours when the Estuary was open to fishing. Indian fishers were interviewed while in their boats, at their riverside camps, or at boat landings in the area to obtain information on the number of each fish species caught, the number of nets fished and the number of hours that were fished. From this information, harvest and variance estimates were generated. During the commercial fishery, a total harvest estimate was calculated on a daily basis and summed for the week. The number of chinook sold during that week was subtracted from the total harvest estimate to derive the subsistence harvest estimate.

When possible, harvested fish were measured to the nearest centimeter fork length, examined for tags and fin-clips, and inspected for seal or otter-bite damage. Snouts were removed from adipose fin-clipped (ad-clip) salmonids for subsequent coded-wire tag (CWT) recovery and identification. A subsample of fall chinook harvested in the Estuary Area were weighed to the nearest pound and these weights were converted to kilograms.

The commercial fishery buying station located near Klamath was monitored from August 9 to August 30. To optimize the nightly sampling effort, the buying station was monitored during the first 6 hours the fishery was open since the majority of the landings occurred during this time. All sampled chinook were examined for ad-clips and the snouts were removed from ad-clipped salmon. Approximately 20% of the examined chinook salmon were randomly sampled for fork length, fin-clip and age (scale) data.

Middle Klamath Area

One field crew consisting of one biologist and one Indian technician, working from a camp near Omagar Creek, monitored the Middle Klamath Area. Under pre-season DOI regulations the Middle Klamath Area is part of Management Area II and was open for fishing under pre-season DOI regulations seven days per week, beginning Monday at 1700 and continuing until the following Monday at 0900. The fishery was monitored 4 to 5 days per week from August 1 to October 15. To monitor the set net fishery, a total net count was conducted by boat after dark over the entire section of river. At dawn, the crew contacted Indian fishers and sampled the set net harvest.

To monitor the drift net fishery, total net counts were conducted by boat between 2000 hours and 0100 hours when drift netting typically occurs. The harvest was sampled either that evening or the following morning. Interviews with drift and set net fishers were conducted in a like manner to those in the Estuary Area.

Upper Klamath Area

One field crew, consisting of one biologist and one Indian technician working out of a camp at Johnson, monitored the Upper Klamath Area. Under DOI regulations, the Upper Klamath Area was included in Management Area II and as such was open during the same period as the Middle Klamath Area. The crew monitored the fishery periodically from August 1 to September 3 and from 4 to 5 days per week from September 4 to October 22. The sampling methodologies for set and drift net fisheries were the same as in the Middle Klamath Area.

Harvest Estimate and Associated Variance Calculations

Definitions and notations for all equations presented herein are summarized as follows:

a = Number of fishing days available in the time period.

$\bar{C}_i$ = Daily mean catch per net or net hour.

$\hat{C}_i$ = Estimated catch for the ith day.

$\hat{C}_p$ = Estimated catch for the pth period.

s = Number of days sampled in the time period.

t = t value at the 95% level.

Y = Daily total number of nets fished.

y = Daily number of nets sampled.

$\hat{V}(\hat{C}_i)$ = Estimated variance of daily catch.

$\hat{V}(\overline{C}_i)$ = Estimated variance of the mean catch per net or net hour.

$\hat{V}(\hat{C}_p)$ = Estimated variance of catch for the pth period.

$\hat{V}(\hat{C})$ = Daily variance of catch.

Estuary, Middle Klamath and Upper Klamath Areas estimates (C_i) of catch by species were calculated by multiplying mean catch per net values by the respective total net count:

$$(1) \quad \hat{C}_i = (\hat{Y})(\overline{C}_i)$$

Since the harvest was not sampled every day fishing occurred, in the Middle Klamath and Upper Klamath Areas, the harvest was estimated for time periods using the equation:

$$(2) \quad \hat{C}_p = (\hat{C}_i)(a/s)$$

These estimates of catch were summed to yield the season harvest estimate.

The variance associated with daily harvest estimates in the Estuary, Middle Klamath, and Upper Klamath Areas was calculated by using the equation (Cochran 1977):

$$(3) \quad \hat{V}(\hat{C}_i) = \left(\frac{\hat{Y} - y}{y}\right) \hat{V}(\overline{C}_i)\hat{Y}^2$$

Because the catch variance is estimated on a daily basis, it must be expanded to include days fished but not sampled. The variance associated with the catch estimate for a time period is calculated by the equation (Cochran 1977):

$$(4) \quad \hat{V}(\hat{C}_p) = \frac{a(a-s) \quad (\hat{C}_i - \overline{C})^2}{s(a-1)} + \frac{a\,[\hat{V}(\hat{C})]}{s}$$

Once the estimate and associated variance were calculated for a period, the corresponding 95% confidence interval was calculated by:

$$(5) \quad 95\%\ \text{Confidence Interval} = \pm\ (t) \sqrt{\frac{\hat{V}(\hat{C}_p)}{a}}$$

Spring Fishery

Under pre-season DOI regulations, the Estuary Area, the Middle Klamath Area and the Upper Klamath Area were open to gill net fishing from Monday at 1700 to the following Monday at 0900. CCFRO, Arcata personnel monitored the fishery from the mouth to Surpur Creek (Estuary and Middle Klamath Areas) on a periodic basis from April 10 through June 12. The area from Johnsons to Weitchpec (Upper Klamath Area) was monitored on a periodic basis from April 10 through July 31.

During the spring monitoring period, Indian fishers were contacted while in their boats, at their riverside camps, or at boat landings in the area. Information obtained included number of fish caught, species identification, mesh size, and number of nets fished. River surveys, including net counts, were scheduled to coincide with hours when fishers typically checked their nets. Indian fishers not contacted on the river were later interviewed at their residences. Chinook were bio-sampled in the spring net fishery in the same manner previously described for the fall fishery.

In 1989 the Bureau of Indian Affairs (BIA) conducted a gill net test fishery on the YIR during June and July to determine the feasibility of the commercial harvest of spring chinook salmon. The test fishery was conducted in the Estuary Area only, from June 13 through July 15. Fishing was allowed from 0700 to 1900 Tuesday through Saturday. Drift net fishing only was allowed on Tuesday and Wednesday and set net fishing only was allowed from Thursday through Saturday. On July 4 regulations were changed to permit fishing only between the hours of 1900 to 0700 and allowing drift net fishing during the outgoing tides and set net fishing during the incoming tides.

CCFRO, Arcata biologists monitored the test fishery daily. Commercially sold chinook were sampled for length and fin clips. Scale samples were collected for age identification. Snouts from adipose fin clipped chinook were collected for CWT analysis.

Procedures used in estimating net harvest for the three Klamath monitoring areas during the 1989 spring fishing period were similar to those of previous years. Estimated daily and monthly net harvest levels were derived by: (1) summing numbers of chinook measured, seen but not measured and reported caught by reliable sources, and (2) dividing these respective sums by the estimated percentage of net harvest these sums were judged to represent. These judgments were based on net counts, a network of contacts on the reservation and on intimate knowledge of the net fisheries. Spring chinook harvest estimates were determined monthly for each of the three areas. During the commercial fishery, a total harvest estimate was calculated for the Estuary Area on a weekly basis and the number of chinook sold during that week was subtracted from the total harvest estimate to derive the subsistence harvest estimate.

Statistical analysis of data was limited to the t-test unless otherwise noted. The data were compared at the 95% confidence level.

RESULTS AND DISCUSSION

Fall Chinook

An estimated 42,211 fall chinook salmon were harvested by the gill net fishery on the Klamath River within the YIR in 1989 (Table 8). Semi-monthly harvest estimates by area are presented in Table 9. The majority of the harvest (88.0%) occurred in the Estuary Area, followed by the Middle Klamath Area (7.5%) and Upper Klamath Area (4.5%). Gill net harvest estimates corresponding to Department of Interior management areas were 37,130 adult fall chinook harvested in Management Area I (Estuary Area) and 5,081 adult fall chinook harvested in Management Area II (Middle and Upper Klamath Areas).

Table 8. The number and percentage of jack and adult fall chinook salmon harvested by the gill net fishery on the Yurok Indian Reservation in 1989.

Area	Jack	(%)	Adult	(%)	Total	(%)
Estuary1/	0	(0.0%)	37,130	(100.0%)	37,130	(88.0%)
Middle Klamath	65	(2.0%)	3,108	(98.0%)	3,173	(7.5%)
Upper Klamath	55	(2.9%)	1,853	(97.1%)	1,908	(4.5%)
Total All Areas	120	(0.3%)	42,091	(99.7%)	42,211	(100.0%)

1/ Estuary harvest includes bot' subsistence and commercial harvest.

An estimated 37,130 adult fall chinook salmon were harvested in the Estuary Area. No jacks (<56 cm) were harvested in the Estuary Area (Table 8). The adult harvest was partitioned into 27,504 (74.1%) salmon for the commercial fishery and 9,626 (25.9%) salmon for the subsistence fishery. Daily harvests in the Estuary Area ranged from 4 chinook salmon on July 26 to 5,269 on August 30. A peak weekly harvest of 9,955 chinook salmon occurred during August 14 to 20. The peak net count of 406 observed during the commercial fishery was the highest since the Service began harvest monitoring in 1981. In 1988, the peak net count was 326, while in 1987 the peak net count was 259. The average peak net count from 1981 to 1986 was 53 with a range of 30 to 85 nets.

In the Middle Klamath Area, 65 jacks and 3,108 adult fall chinook salmon were harvested (Table 8). Daily harvest levels ranged from 0, occurring frequently during the last two weeks in July, to 361 on September 9 with a peak

TABLE 9. Semi-monthly gill net harvest estimates of fall chinook salmon from the three monitoring areas of the Yurok Indian Reservation in 1989.

	NET HARVEST MONITORING AREA				
Time Period	Estuary 1/	Middle Klamath	Upper Klamath	Semi-Monthly Totals (All Areas)	Cumulative Seasonal Total
July 16 - 31	1,003 2/ 53 3/ 5.3% 4/ 136 5/	0 - - -	0 - - -	1,003	1,003
August 1 - 15	6,970 97 1.4% 4,465	110 19 17.3% 6	63 0 0 7	7,143	8,146
August 16 - 31	27,221 192 0.7% 16,427	267 27 10.1% 83	10 17 170.0% 0	27,498	35,644
September 1 - 15	1,936 472 24.4% 1,000	1,930 144 7.5% 663	1,904 93 8.5% 404	4,960	40,604
September 16 - 30	0 - - -	800 40 5.0% 344	483 26 5.4% 201	1,283	41,887
October 1 - 15	0 - - -	66 13 19.7% 5	240 32 13.3% 78	306	42,193
October 16 - 31	0 - - -	0 - - -	18 28 156.6% 1	18	42,211
Area Season Total	37,130 814 2.2% 22,073	3,173 243 7.7% 1,101	1,908 196 10.3% 684		42,211 1,253 3.0% 23,858

1/ Includes commercial and subsistence fishery.
2/ Harvest estimate.
3/ 95% Confidence interval.
4/ Confidence interval percentage.
5/ Accounted number of fall chinook.

weekly harvest of 1,100 occurring between September 4 and 10. Fishing effort in the Middle Klamath Area was greatly reduced, ranging from 0 to 7 nets fished per night, during the time the Estuary Area was open to commercial fishing but increased to "traditional" levels after the commercial fishery was closed.

Fifty-five jacks and 1,853 adult fall chinook were harvested in the Upper Klamath Area (Table 8). Daily harvest levels in the Upper Klamath Area ranged from 0 on many occasions in late July and August to 171 on September 13. A peak weekly harvest of 647 fall chinook occurred during September 11 to 17. A decrease in fishing effort in the Upper Klamath Area occurred as it did in the Middle Klamath Area during the Estuary commercial fishery. Effort levels after the commercial fishery period were similar to those observed in past years.

The weighted mean length of chinook jacks harvested in 1989 (48.8 cm) was significantly larger ($p<0.05$) than jacks harvested in 1988, but not significantly different from jacks harvested in 1986 and 1987 (Figure 10). The weighted mean length of harvested adults from all the sampling areas combined (80.6 cm) was significantly greater ($p<0.05$) from that of adults harvested in 1987 and 1988.

The mean length of adults harvested in the Estuary Area (80.9 cm) was significantly greater ($p<0.05$) than adults harvested in the Middle and Upper Klamath Areas (76.7 cm and 76.3 cm, respectively) (Figure 11). Mean length of adults harvested in the Middle Klamath Area was not significantly different ($p>0.05$) than that of adults harvested in the Upper Klamath Area.

Mean length of adults harvested in the Estuary Area in 1989 was significantly greater ($p<0.05$) than mean lengths of adults harvested in 1986-1988 (Figure 12).

Lengths and weights from 371 fall chinook harvested in the Estuary were used to calculate a length- weight relationship (Figure 13). Mean length and weight of the sampled chinook was 82.0 cm and 8.2 kg, respectively. The formula describing the length-weight relationship is:

$$\text{Weight (kg)} = 10^{(-4.620\ +\ 2.885\ \text{Log(fork length)})} \quad , \ r^2 = 0.84$$

Comparing weights using the respective annual length-weight relationships, a 75 cm chinook returning in 1989 would have weighed 6.2 kg. A 75 cm chinook would have weighed 6.1 kg in 1988, 5.8 kg in 1987, 5.5 kg in 1986, and 6.3 kg in 1985.

Ad-clips were observed on 7.9% of the fall chinook mark sampled in all monitoring areas combined and on 8.0%, 6.0% and 7.0% of the fall chinook mark sampled in the Estuary, Middle Klamath and Upper Klamath Areas, respectively. Mean length of ad-clipped chinook harvested in all monitoring areas combined was 76.2 cm ($s=6.14$, $n=247$) for adults and 48.2 cm ($s=2.05$, $n=5$) for jacks.

A total of 20,525 (74.6%) of the 27,504 commercially sold fall chinook salmon were sampled for ad-clips. Ad-clips were observed on 1,658 (8.1%) of the sampled chinook. Mean length of ad-clipped chinook was 78.5 cm ($s=5.40$, $n=1658$). From the 20,525 commercially sold fall chinook sampled for ad-clips, 1,010 (4.9%) were randomly sampled for length and age data. A total of 964 usable scale samples were analyzed. The mean length of these randomly sampled chinook salmon was 78.2 cm ($s=5.99$, $n=964$).

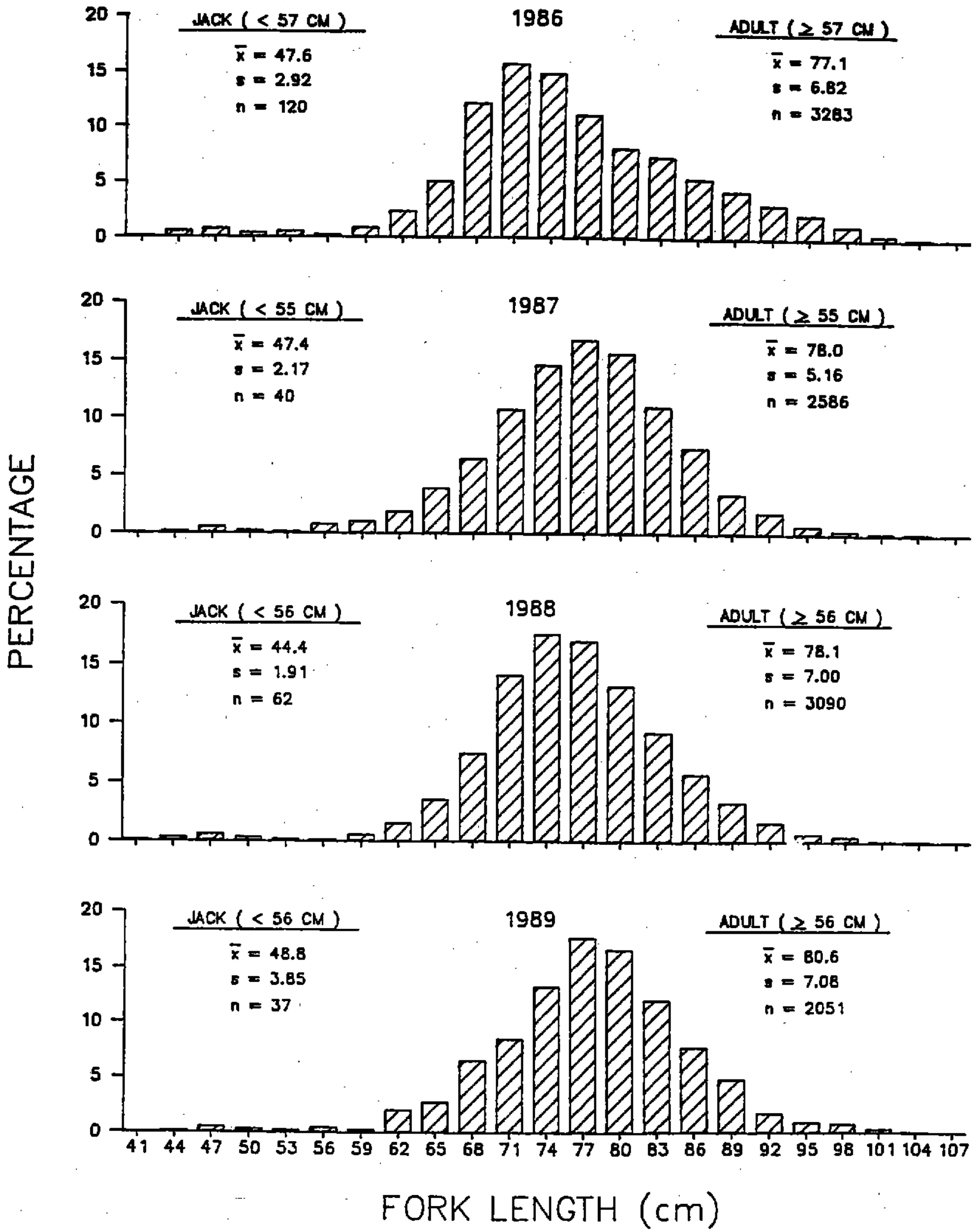

FIGURE 10. Length frequency distributions of fall chinook salmon harvested by Indian gill net fishers on the Yurok Indian Reservation During 1986-1989.

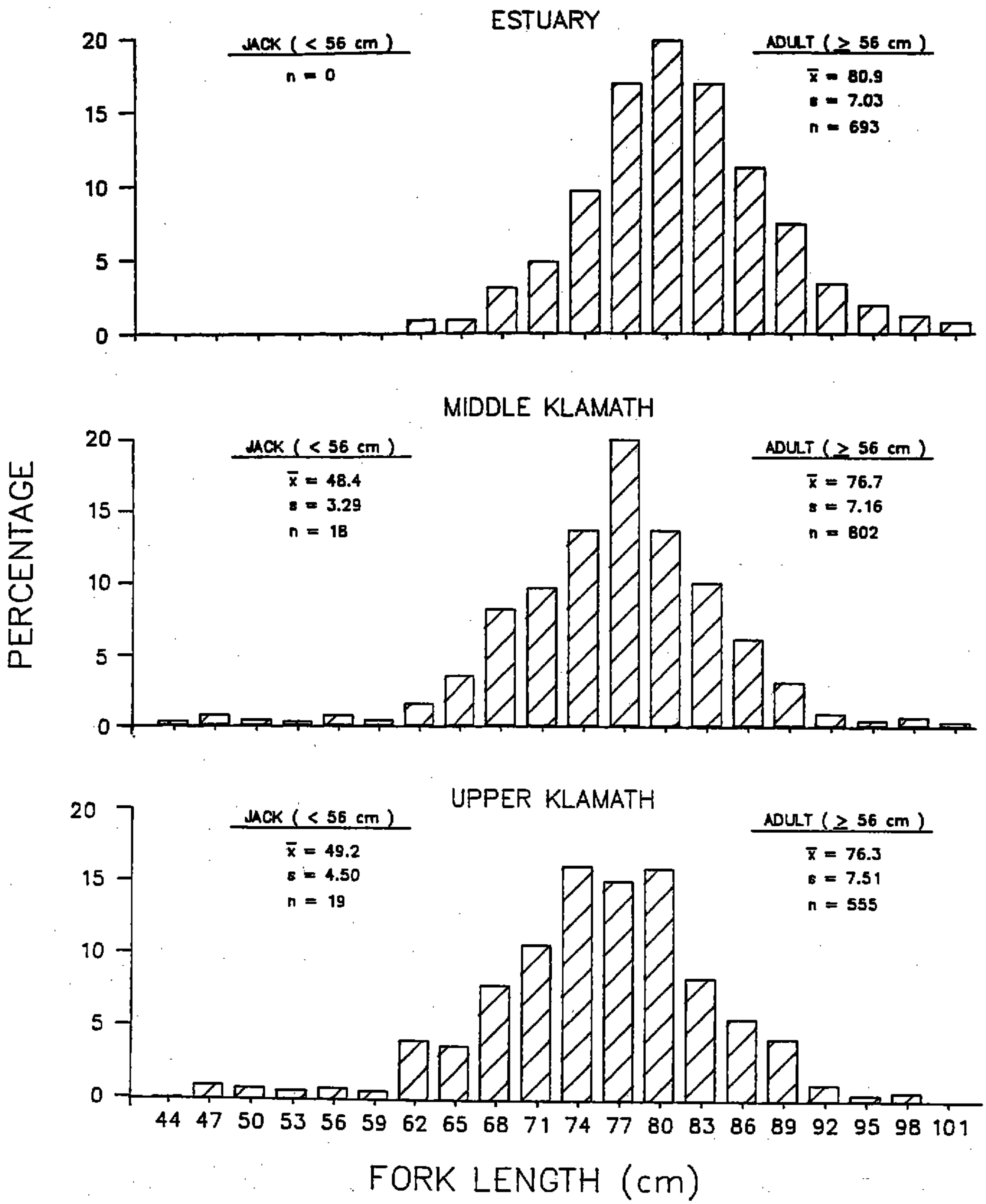

FIGURE 11. Length frequency distributions of fall chinook salmon harvested by Indian gill net fishers in the Estuary, Middle Klamath and Upper Klamath Areas in 1989.

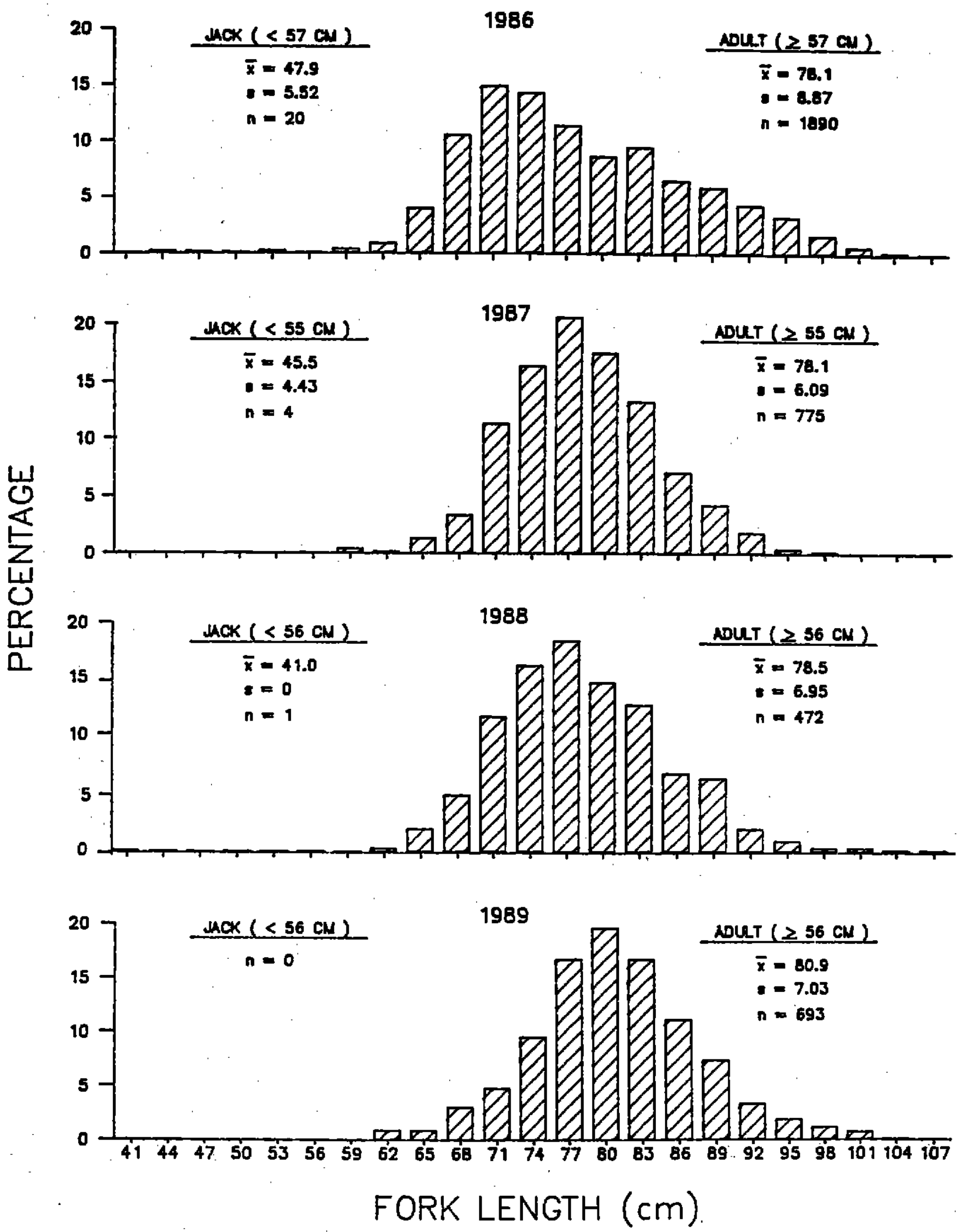

FIGURE 12. Length frequency distributions of fall chinook salmon harvested by the Indian gill net fishers in the Estuary Area during 1986-1989.

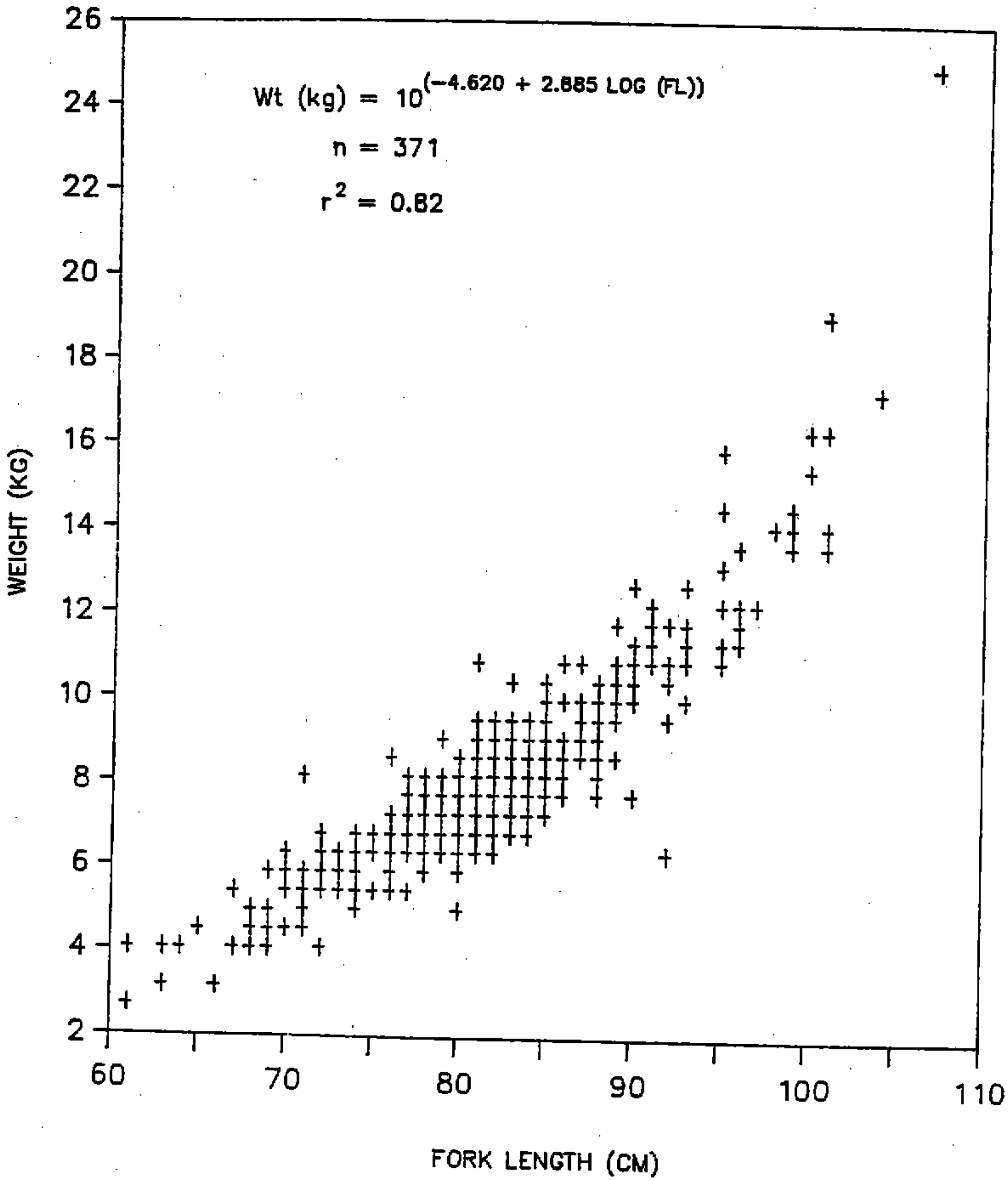

FIGURE 13. Length-weight relationship of fall chinook harvested by Indian gill net fishers in the Estuary Area of the Yurok Indian Reservation in 1989.

TABLE 10. Fall chinook age composition for each week of the commercial fishery, and the beach seine age composition before, during, and after the commercial fishery. [n = sample number, (%) = percent of total sample]

	AGE 2	AGE 3	AGE 4	AGE 5+
	n (%)	n (%)	n (%)	n (%)
Commercial Fishery:				
Aug 9-13	0 (0.0)	29 (13.7)	170 (80.6)	12 (5.6)
Aug 16-20	0 (0.0)	31 (11.1)	237 (84.6)	12 (4.3)
Aug 23-27	0 (0.0)	50 (15.9)	254 (80.6)	11 (3.5)
Aug 30	0 (0.0)	21 (13.3)	129 (81.7)	8 (5.1)
Total	0 (0.0)	131 (13.6)	790 (82.0)	43 (4.4)
Beach Seine:				
July 17-Aug 8	0 (0.0)	17 (18.7)	68 (74.7)	6 (6.6)
Aug 9-30	7 (2.6)	71 (26.5)	178 (66.4)	12 (4.5)
Sept 1-22	38 (6.5)	275 (47.3)	256 (44.0)	13 (2.2)
Season Total	45 (4.8)	363 (38.6)	502 (53.3)	31 (3.3)

The age composition of commercially caught chinook salmon shows the selectivity of the gill net fishery towards larger and older fish (Table 10). The age composition of the weekly harvest did not vary substantially during the commercial season, but it did differ from weekly age composition data collected from the beach seining operation. The beach seine age composition data shows a predominance of age 4 chinook in the Estuary Area through August 30. After this date, through September 22, age 3 chinook slightly outnumber age 4. This information supports the argument that the age 4 chinook enter the river earlier than the age 3, and that the gill net fishery selects for the age 4 chinook. The data collected at the commercial buying station probably under estimated the percentage of age 3 chinook harvested due to the 66 cm total length (61 cm fork length) minimum size limit imposed on commercially landed chinook salmon. This bias is thought to be small since only a small percentage of 3-year-old chinook (1.5%) sampled in the beach seining operation were less than 61 cm fork length.

Bite marks from seals (Phoca vitulina) or sea lions (Zalophus californicus and Eumetopias jubatus) were observed on 3.4% of the chinook salmon sampled in the Estuary Area in 1989. This is the highest value for "seal" bites since 1984 (Table 11). The 1987 Annual Report (USFWS 1988) suggested that the low frequency of "seal" bites seen that year may have been due to the regulation requiring constant net monitoring by the fishers, which would decrease the opportunities for "seal" depredation. This regulation was also in effect in 1988, but since the commercial buyer was more selective in the purchase of fish, some fishers may have discarded damaged fish, which would have reduced their probability of being sampled. The high incidence of "seal" bites in 1989 may be a product of a growing seal and sea lion population. It may also be that the high fishing effort in the Estuary Area is attracting and conditioning the animals to the nets and enmeshed fish.

Seal bites were observed on 1.5% and 3.5% ~~of~~ the fall chinook sampled in the Middle Klamath and Upper Klamath ~~Areas~~, respectively. Percentages of seal bitten fish represent minimum values of depredation because they do not account for fish removed from nets by predators or severely damaged fish that were discarded and not reported as being caught (Table 11).

Bites attributed to the river otter (Lutra canadensis) were observed on 1.5% of the fall chinook sampled in the Middle Klamath Area and on 5.8% of the fall chinook sampled in the Upper Klamath Area (Table 11).

A survey of marine mammal interactions with gill nets was conducted during the commercial fishery. A total of 1,326 interviews indicated that there was an average of 0.26 interactions per net fished, with a resulting 0.59 chinook lost per interaction (Table 12). This equated to 742 chinook lost to "seal" depredation, based on the expanded number of interactions for the peak number of nets. Many interviewed fishers were not able to confirm the loss of a fish when an interaction occurred, e.g. it was dark and too difficult to see and/or no fish parts remained in the net to confirm a loss. Therefore, the depredation number should be considered a minimum.

TABLE 11. Percent of sampled fall chinook with "seal" (seal and sea lion) and river otter bites from the Estuary, Middle, and Upper Klamath sample areas of the Yuork Indian Reservation from 1983-1989. * = data not recorded.

	Estuary		Middle Klamath		Upper Klamath	
Year	Seal	Otter	Seal	Otter	Seal	Otter
1983	14.2	0.0	*	*	*	*
1984	7.3	0.0	*	3.7	*	4.3
1985	3.2	0.0	*	1.7	*	4.4
1986	1.8	0.0	1.0	7.0	2.6	2.5
1987	1.8	0.0	1.0	7.0	1.6	2.5
1988	1.3	0.0	0.6	0.7	2.3	3.5
1989	3.4	0.0	1.5	1.5	2.4	5.8

TABLE 12. Summary of marine mammal interactions with Indian gill net fishers in the Klamath River Estuary during the 1989 fall chinook commercial fishery.

Date	Fishers Interviewed	Nets	Interactions	Number of Lost Fish	Peak Nets
Aug 9-13	326	480	198	146	1,220
Aug 16-20	373	563	125	61	1,499
Aug 23-27	532	820	161	73	1,692
Aug 30	95	156	39	31	406
Totals	1,326	2,019	523	311	4,817

Spring Chinook

In 1989, an estimated 4,775 adult spring chinook (including 206 that were sold in the test commercial fishery) were harvested on the YIR during the spring net harvest period, April to mid-July (Table 13). This was the highest level of spring chinook harvest observed since net harvest monitoring began in 1979. The majority of the 1989 harvest (61%) occurred during May. In 1988 the majority of the harvest (74%) occurred in June and July and in 1987 in July (55%) (Figure 14). In contrast to 1988 when 57% of the spring chinook harvest occurred in the Estuary Area, the majority of the 1989 harvest took place in the Middle and Upper Klamath Areas (42% and 40%, respectively) with only 18% of the harvest occurring in the Estuary Area (Figure 15). The high level of harvest in the Middle and Upper Klamath Areas and low harvest level in the Estuary Area in 1989 can be attributed to the timing of the 1989 spring run. Up-river fishers are usually in place and fishing in their sites from the beginning of the season, whereas the Estuary Area receives increasing fishing pressure as the fall chinook season nears. The protracted run timing observed in 1987 and 1988 accounts for the high levels of harvest observed in the Estuary Area during these years, most of which occurred in July (Table 13).

The mean fork length of adult spring chinook (73.7 cm) harvested in 1989 was significantly larger ($p < 0.05$) than the mean fork length of spring chinook harvested in 1987 and 1988, but was not significantly different ($p > 0.05$) than the mean fork length of 1986 (Figure 16).

Ad-clips were observed on 13.8% of spring chinook harvested during the spring fishery. The mean fork length of ad-clipped spring chinook was 72.9 cm (s=5.27, n=49).

Spring and fall chinook harvest estimates on the YIR for 1977 through 1989 are summarized in Table 14.

Prior to the test commercial fishery on spring chinook, concerns were raised by resource agencies and user groups that it could negatively impact wild spring chinook, steelhead, sturgeon, and shad populations. These impacts were not realized in 1989. probably due to the low effort during this fishery.

TABLE 13. Monthly spring chinook harvest estimates on the Yurok Indian Reservation, by sample area for 1986-1989.

Year	Month	Estuary	Middle Klamath	Upper Klamath	Total
1986	April	5	54	98	157
	May	6	37	76	119
	June	15	71	169	255
	July	15	5	155	175
	Total	41	167	498	706
1987	April	10	51	18	79
	May	11	115	120	246
	June	250	10	169	429
	July	538	0	402	940
	Total	809	176	709	1694
1988	April	2	20	18	40
	May	251	178	294	723
	June	225	512	227	964
	July	1199	0	0	1199
	Total	1677	710	539	2926
1989	April	123	445	191	759
	May	360	1331	1217	2908
	June	307	232	479	1018
	July	60	17	13	90
	Total	850	2025	1900	4775

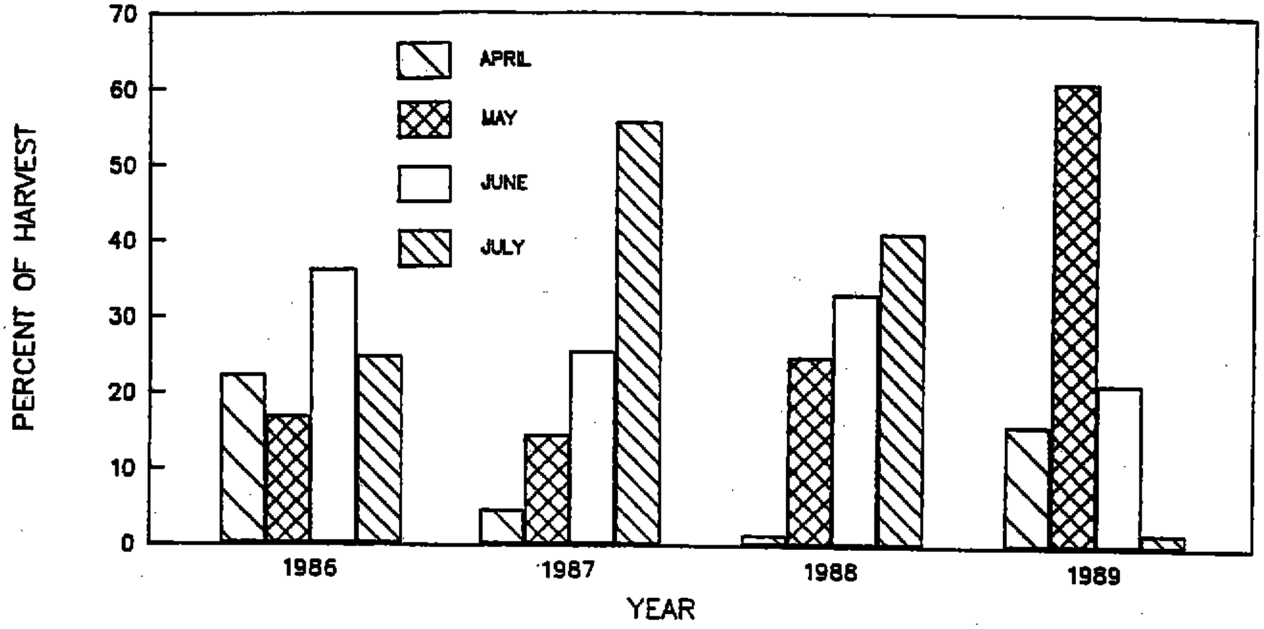

FIGURE 14. Monthly spring chinook harvest on the Yurok Indian Reservation, 1986-1989.

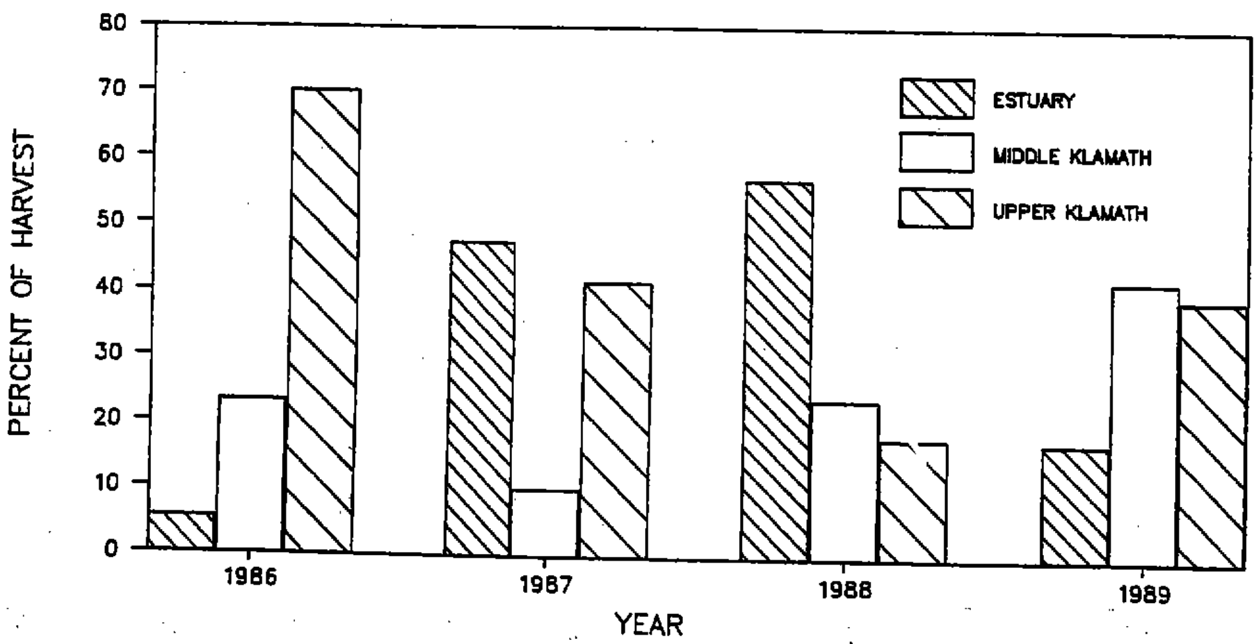

FIGURE 15. Percent total harvest of spring chinook by sample area on the Yurok Indian Reservation, 1986-1989.

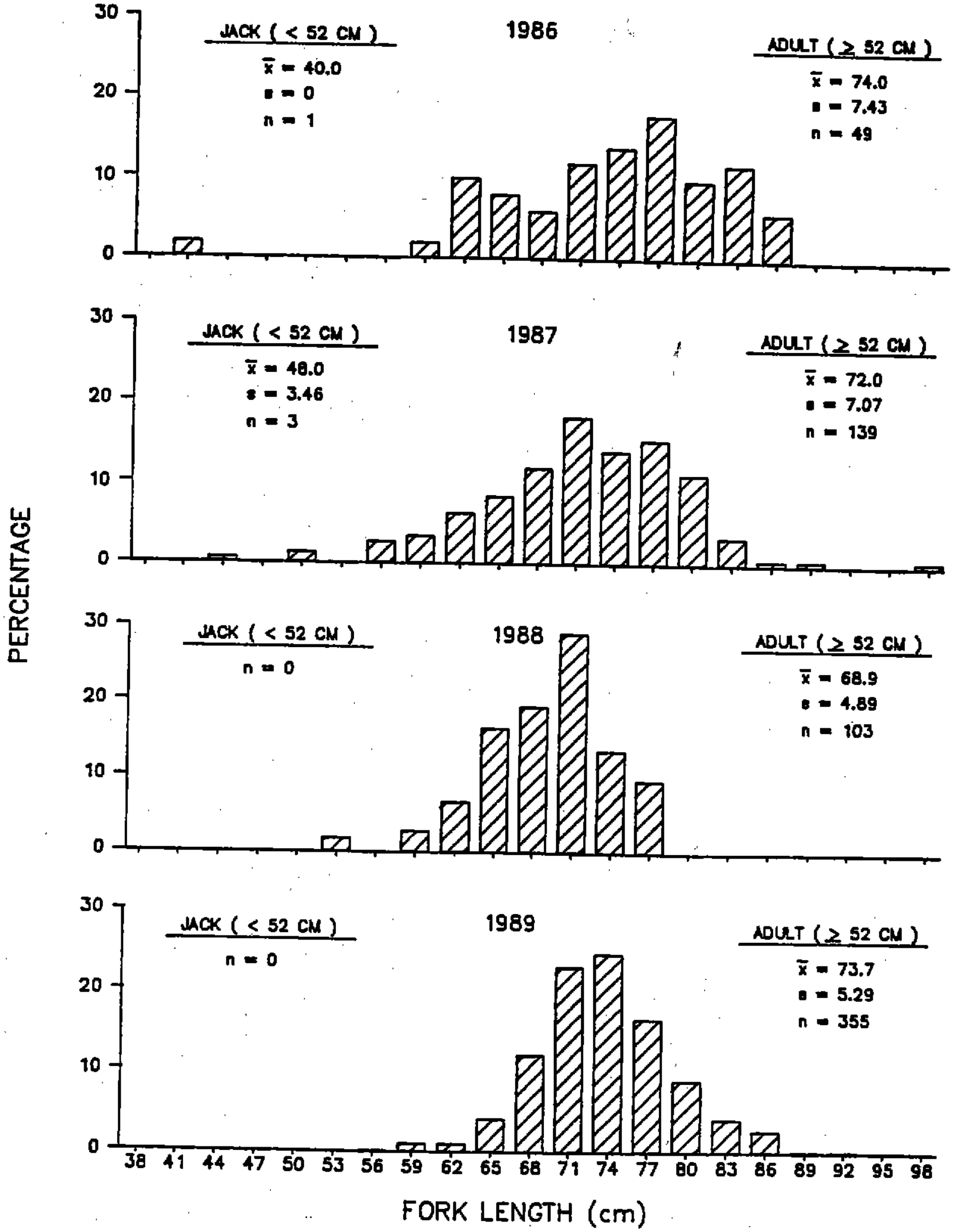

FIGURE 16. Length frequency distributions of spring chinook salmon harvested by Indian gill net fishers on the Yurok Indian Reservation during 1986-1989.

TABLE 14. Estimates of spring and fall chinook salmon harvested by the gill net fisheries on the Yurok Indian Reservation from 1977 through 1989.

	SPRING CHINOOK			FALL CHINOOK		
Year	Jacks	Adults	Total	Jacks	Adults	Total
1977	—	—	—	2,700	27,300	30,000
1978	—	—	—	1,800	18,200	20,000
1979	—	—	—	1,350	13,650	15,000
1980	20	980	1,000	987	12,013	13,000
1981	35	1,722	1,757	2,328	31,190	33,518
1982	35	2,440	2,475	1,597	12,859	14,456
1983	5	510	515	133	6,500	6,633
1984	12	247	259	315	17,500	17,815
1985	45	1,074	1,119	608	9,625	10,233
1986	14	692	706	568	20,319	20,887
1987	48	1,646	1,694	153	48,114	48,267
1988	8	2,918	2,926	311	46,581	46,892
1989	-	4,775	4,775	120	42,091	42,211

RECOMMENDATIONS

The management of the lower Klamath River Indian gill net fishery has been relatively low-key and of minimal biological concern before 1987. As long as the ocean fisheries were the primary harvester of the fall chinook resource and the gill net fishery was relegated to subsistence and ceremonial harvest of chinook, concern over fishery impacts centered on the ocean harvest. With the agreement between ocean and in-river user groups in 1987 to share the allowable harvest, and to shift a substantial part of that allowable harvest in-river, an increased importance as to how the Indian gill net fishery is managed should be recognized.

With the increased allowable in-river harvest has come the creation of a Indian commercial gill net fishery in the estuary. Fishing effort has been substantially higher during the commercial fishery from 1987 through 1989 than in comparable periods before the formation of the commercial fishery. There have been two major impacts on the fall chinook salmon resource. The first is an imbalance in the harvest towards Iron Gate stocks. During the 1989 commercial fishery (August 9 through August 30) 72.6% of the estimated harvest of ad-clipped chinook originating from basin hatcheries were from IGH or from IGH stock reared at off-site facilities on the Klamath River and released at those facilities or back at IGH. Fall chinook from TRH and from TRH stock reared at off-site facilities on the Trinity River and released at those facilities accounted for 16.0%. IGH stock reared and released by the HVBC at Tish Tang Creek (Trinity River) accounted for 10.8% of the harvested ad-clipped chinook from basin hatcheries. Spring chinook from TRH accounted for the remaining 0.6%. The breakdown for the entire fall fishery in the estuary (July 16 through September 2) for the same categories of stocks were 72.6%, 16.0%, 10.6%, and 0.8%, respectively. There is little difference between the two sets of figures because 85.8% of all fall chinook caught in the estuary was during the commercial fishery period. This imbalance of impacts on the hatchery stocks can be attributed to the timing of the commercial fishery and the run timing of the two stocks. At the time of the commercial fishery, Iron Gate stocks predominated in the estuary while TRH stocks did not contribute heavily to the harvest until the third week of August.

The second major impact is an imbalance towards the harvest of older (4- and 5-year-old) chinook. The age composition of the commercial harvest in 1989 was 0.0% age 2, 13.6% age 3, 82.0% age 4, and 4.5% age 5. Age composition of beach seine captured chinook for the period of the commercial fishery was 4.8% age 2, 38.6% age 3, 53.3% age 4 and 3.3% age 5.

We believe the shortening of the estuary fishery from July 15 through September 15 to July 15 through the end of August was the primary cause of these impacts. Net selectivity has also contributed to the imbalance, although the effect of net selectivity was recognized prior to the allocation agreements and was factored into the allocation model. In accordance with the role of technical advisor to the Bureau of Indian Affairs and as stewards of the fisheries resources in the Klamath basin, the Fish and Wildlife Service makes the following recommendations concerning management of the Indian gill net fishery:

- **Spread the harvest into September to balance the harvest between Klamath and Trinity River stocks.** This could be accomplished by delaying the start of the commercial fishery until after August 15 or by splitting the season into an August segment (50-60% of the quota) and a September segment (September 1 until attainment of full harvest quota). This could create a one to two week closure between the fishing segments. This would afford additional protection for Klamath natural stocks which is desirable realizing the current restoration efforts and would balance the impacts between Iron Gate and Trinity River Hatchery stocks.

- **Institute a mesh size restriction for the Estuary Area.** This could target the smaller age-3 chinook and allow greater escapement for the larger, more fecund age-4 chinook. A larger total in-river harvest allocation could be achieved if the shift to age-3 chinook was successful.

- **Eliminate the 66 cm total length size limit on commercially sold fish.** This has no biological significance and could increase the total number of fish sold and prevent small fish from being tossed back. Cooperation with the State of California is necessary, however, because current California State laws inhibit the commercial buyers from processing fish less than 66 cm total length. Failing that, a tribal enterprise could be set up to utilize small fish.

- **Nets fished in the Estuary should be attended at all times.** By constantly tending the nets, the loss of salmon to seal and sea lion depredation could be reduced.

- **Openings of management areas should be concurrent to prevent effort shift.**

CODED-WIRE TAG RECOVERY INVESTIGATIONS

INTRODUCTION

The use of coded wire tags (CWT) on Pacific salmon enables hatchery managers to evaluate the success or failure of various hatchery rearing and release strategies. CWT recovery information allows fishery harvest managers to assess the contribution of different stocks to ocean and inriver fisheries. It is also valuable in determining the extent that hatchery stocks utilize natural areas for spawning.

There are three sources of CWT chinook from within the Klamath River basin:

1) Two hatcheries are operated within the Klamath River Basin. Iron Gate Hatchery (IGH) is located at the base of Iron Gate Dam (RKM 249) on the Klamath River and Trinity River Hatchery (TRH) is located at the base of Lewiston Dam (RKM 178) on the Trinity River. During most years CWTs are applied to a portion of each chinook release group.

2) There are also numerous small scale facilities along both the Klamath and Trinity Rivers that rear fall chinook for enhancement purposes. Some of these facilities CWT their production so that their contribution to the resource can be assessed.

3) CDFG and USFWS are involved in tagging operations of natural stocks from major tributaries within the Klamath Basin. This program was initiated by CDFG in 1983. The goal of this program is to provide information of natural stocks of chinook salmon.

While conducting net harvest monitoring operations on the YIR in 1989, CCFRO, Arcata biologists also collected the snouts from AD-CWT chinook and associated biological information so that the impacts of the gill net fishery on hatchery stocks and potentially natural stocks could be assessed.

METHODS

Methods of acquiring CWT samples during net harvest monitoring activities were previously described in this report. CWTs from the field samples were recovered from salmon heads with the aid of a magnetic field detector. Tags were then decoded with the aid of a Reichert 580 dissecting scope, Hitachi CCTV camera and Koyo video monitor. If no tag was detected, the head was dissolved in a potassium hydroxide solution. A magnet was then stirred through the resultant slurry to recover tags that did not activate the magnetic field detector.

Recovery data for each CWT group were expanded to estimate contribution to the net harvest by time and area. Contribution estimates are the product of the number of tags recovered for each tag code and an expanded tag factor. The expansion adjusts for that portion of the harvest not sampled, the non-recovery of heads from observed adipose fin-clipped fish and tags lost during dissection.

The expanded tag factor varies with each sampling period and is the product of three ratios:

(1) $\text{Sampling Ratio} = \dfrac{\text{Estimated Net Harvest}}{\text{Number of Fish Examined for Ad-Clips}}$

(2) $\text{Head Recovery Ratio} = \dfrac{\text{Number of Ad-Clipped Fish Observed}}{\text{Number of Heads Recovered}}$

(3) $\text{Lost Tag Ratio} = \dfrac{\text{Number of Heads with Tags}}{\text{Number of Tags Decoded}}$

Contribution rates of individual CWT groups to the Indian net fishery were calculated and expressed as a percentage:

(4) $\text{Contribution Rate (\%)} = \dfrac{\text{Estimated CWT Harvest}}{\text{Number of Tagged Fish Released}} \times 100$

The contribution rate compensates for unequal release-size bias and allows for comparison of different release strategies.

Statistical analysis of data was limited to the t-test unless otherwise noted. The data were compared at the 95% confidence level.

RESULTS AND DISCUSSION

Fall Fishery

A total of 23,150 (54.8%) of the estimated 42,211 chinook salmon harvested during the 1989 fall fishery (July 16 - October 22) on the YIR were examined for adipose fin clips (AD-clips) (Table 15). Snouts were collected from 1,783 (97.9%) of the AD-clipped chinook and 1,445 CWTs were recovered. Fifteen percent of the snouts collected did not contain a CWT.

An estimated 2,768 CWT chinook salmon were harvested during the fall fishery (Table 16). An additional 487 chinook that were AD-clipped but did not contain a CWT were harvested. Forty-three different tag codes were recovered representing: 4 fingerling and 8 yearling fall chinook release groups from IGH; 10 yearling release groups from IGH but reared at offsite facilities; 2 fingerling, 5 yearling and 1 yearling-plus fall chinook release groups from TRH; 3 yearling spring chinook release groups from TRH; 1 offsite fingerling release group from TRH; 2 yearling release groups from the Hoopa Valley Business Council's hatchery; 2 fingerling natural stock release groups from Bogus Creek;

Table 15. Mark sample data collected during the 1989 fall fishing on the Yurok Indian Reservation.

	Monitoring Area				
	Estuary Commercial	Estuary Commercial & Subsistence	Middle Klamath	Upper Klamath	Total
Estimated Harvest	27,504	37,130	3,173	1,908	42,211
Mark Sampled	20,525	21,391	1,089	670	23,150
Observed Ad-Clips	1,658	1,710	63	49	1,822
Collected Snouts	1,658	1,682	54	47	1,783
Tags Recovered	1,352	1,353	50	42	1,445
No Tags	267	270	2	2	274

TABLE 16. Actual and expanded coded-wire tag recoveries for chinook salmon from the fall fishery (July 16 - October 22) on the Yurok Indian Reservation in 1989.

Tag Code	Brood Year	Race	Hatchery1/ of Origin	Release2/ Type	RESERVATION MONITORING AREA Estuary		Middle Klamath		Upper Klamath		All Areas	
06-52-03	1985	Fall	HVBC3/	Y	0	0.00	0	0.00	3	9.14	3	9.14
06-52-04	1985	Fall	HVBC4/	Y	0	0.00	1	3.76	0	0.00	1	3.76
06-52-05	1985	Fall	HVBC5/	Y	141	254.85	6	19.93	4	13.18	151	287.96
06-53-01	1986	Fall	IGH6/	Y	0	0.00	1	2.96	5	15.74	6	18.70
06-56-22	1984	Fall	TRH	Y	2	3.30	0	0.00	0	0.00	2	3.30
06-56-23	1985	Fall	TRH	F	49	95.32	3	10.75	2	6.25	54	112.32
06-56-24	1984	Fall	TRH	Y+	8	12.91	0	0.00	2	6.46	10	19.37
06-56-25	1985	Fall	TRH	Y	126	241.51	8	26.65	4	11.35	138	279.51
06-56-27	1986	Fall	TRH	Y	13	23.78	3	9.88	3	9.73	19	43.39
06-56-28	1986	Fall	TRH	Y	2	2.84	1	2.96	0	0.00	3	5.80
06-56-30	1986	Fall	TRH7/	F	1	1.42	0	0.00	0	0.00	1	1.42
06-59-22	1984	Fall	IGH	Y	14	24.42	0	0.00	0	0.00	14	24.42
06-59-25	1983	Fall	IGH	Y	0	0.00	1	3.93	0	0.00	1	3.93
06-59-27	1984	Fall	IGH	F	20	31.27	0	0.00	1	2.55	21	33.82
06-59-28	1984	Fall	IGH	F	9	16.59	2	6.70	0	0.00	11	23.29
06-59-29	1985	Fall	IGH	Y	381	684.05	4	17.68	4	12.07	389	713.80
06-59-34	1985	Fall	IGH	F	32	60.03	1	3.93	1	2.55	34	66.51
06-59-35	1984	Fall	IGH	Y	3	5.18	0	0.00	1	3.27	4	8.45
06-59-36	1987	Fall	IGH	Y	0	0.00	1	3.06	0	0.00	1	3.06
06-59-42	1986	Fall	IGH	Y	2	4.08	0	0.00	0	0.00	2	4.08
06-59-60	1986	Fall	IGH	F	4	6.60	2	7.69	0	0.00	6	14.29
06-61-27	1984	Fall	TRH	F	1	1.88	0	0.00	0	0.00	1	1.88
06-61-28	1984	Fall	TRH	Y	2	3.76	0	0.00	0	0.00	2	3.76
06-61-43	1984	Spring	TRH	Y	1	1.42	0	0.00	0	0.00	1	1.42
06-61-44	1985	Spring	TRH	Y	1	1.37	0	0.00	0	0.00	1	1.37
06-61-46	1986	Spring	TRH	Y	8	18.94	0	0.00	0	0.00	8	18.94
06-63-02	1985	Fall	IGH8/	Y	10	17.45	0	0.00	0	0.00	10	17.45

1/ BCWILD - Wild Stock Assessment Program - Bogus Creek Stock
CRH - Cole Rivers Hatchery - Rogue River
HVBC - Hoopa Valley Business Council Hatchery
ICP - Indian Creek Ponds - Rogue River
IGH - Iron Gate Hatchery
SRWILD - Wild Stock Assessment Program - Shasta River Stock
TRH - Trinity River Hatchery

2/ F (Fingerling) - May or June release.
Y (Yearling) - Late September to December release
Y+ (Yearling-Plus) - February or later release

3/ Supply Creek Stock - Trinity River

4/ Mill Creek Stock - Trinity River

5/ IGH Stock, reared and released at Tish Tang Creek - Trinity River

6/ Reared and released at Cappell Creek - Klamath River

7/ Reared and released at Ambrose Pond - Trinity River

8/ Reared at Fall Creek - Klamath River - released at IGH

TABLE 16. (Continued)
Actual and expanded coded-wire tag recoveries for chinook salmon from the fall fishery (July 16 - October 22) on the Yurok Indian Reservation in 1989.

Tag Code	Brood Year	Race	Hatchery1/ of Origin	Release2/ Type	Estuary		Middle Klamath		Upper Klamath		All Areas	
					RESERVATION MONITORING AREA							
06-63-03	1985	Fall	IGH8/	Y	73	131.81	4	14.85	2	7.40	79	154.06
06-63-04	1985	Fall	IGH8/	Y	46	84.34	3	10.75	1	3.70	52	98.79
06-63-05	1985	Fall	IGH8/	Y	56	99.05	0	0.00	0	0.00	56	99.05
06-63-06	1985	Fall	IGH8/	Y	61	105.16	2	10.86	3	8.80	66	124.82
06-63-07	1985	Fall	IGH8/	Y	68	110.84	2	6.99	2	5.10	72	122.93
06-63-08	1985	Fall	IGH8/	Y	50	85.75	2	6.12	0	0.00	52	91.87
06-63-09	1985	Fall	IGH8/	Y	99	169.51	0	0.00	1	3.70	100	173.21
06-63-18	1985	Fall	IGH	Y	49	86.71	2	7.69	1	3.70	52	98.10
06-63-32	1986	Fall	IGH	Y	16	28.54	1	3.06	2	6.25	19	37.85
07-35-41	1985	Fall	CRH	Y	5	7.92	0	0.00	0	0.00	5	7.92
07-35-43	1985	Fall	ICP	Y	1	6.02	0	0.00	0	0.00	1	6.02
B6-08-02	1983	Fall	BCWILD	F	1	1.42	0	0.00	0	0.00	1	1.42
B6-08-05	1985	Fall	SRWILD	F	1	1.42	0	0.00	0	0.00	1	1.42
B6-08-06	1985	Fall	SRWILD	F	5	8.38	0	0.00	0	0.00	5	8.38
B6-08-10	1986	Fall	SRWILD	F	7	12.00	0	0.00	0	0.00	7	12.00
B6-09-01	1986	Fall	BCWILD	F	3	4.62	0	0.00	0	0.00	3	4.62
TOTAL TAGS					1373	2456.46	50	180.20	42	130.94	1465	2767.60
AD - NO TAGS					270	473.85	2	6.12	2	7.02	274	486.99
TOTAL					1643	2930.31	52	186.32	44	137.96	1739	3254.59

1/ BCWILD - Wild Stock Assessment Program - Bogus Creek Stock
CRH - Cole Rivers Hatchery - Rogue River
HVBC - Hoopa Valley Business Council Hatchery
ICP - Indian Creek Ponds - Rogue River
IGH - Iron Gate Hatchery
SRWILD - Wild Stock Assessment Program - Shasta River Stock
TRH - Trinity River Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to December release
Y+ (Yearling-Plus) - February or later release

3/ Supply Creek Stock - Trinity River

4/ Mill Creek Stock - Trinity River

5/ IGH Stock, reared and released at Tish Tang Creek - Trinity River

6/ Reared and released at Cappell Creek - Klamath River

7/ Reared and released at Ambrose Pond - Trinity River

8/ Reared at Fall Creek - Klamath River - released at IGH

3 fingerling natural stock release groups from the Shasta River; and 2 yearling release groups from rearing projects on the Rogue River.

Fall chinook originating from IGH (onsite and offsite releases combined) comprised 69.9% of the estimated 2,768 CWT chinook harvested on the YIR in 1989, while fall chinook originating from TRH accounted for only 17.0% (Table 17). Tag code 06-52-05 which was IGH stock reared and released at Tish Tang Creek on the Trinity River accounted for 10.4% of the estimated harvest for tagged chinook. Other tag groups (TRH spring chinook, Trinity Wild Stocks, Klamath Wild Stocks, and Rogue River Stocks) made up the remaining 2.8% of the harvest of CWT chinook. IGH stock reared at the Fall Creek Ponds rearing facility and released at IGH (tag codes 06-63-02 through 06-63-09) was a major contributor, 31.9%, to the harvest of CWT chinook.

When comparing only onsite releases of fall chinook from Klamath basin hatcheries, IGH releases made up 68.7% of the harvest of CWT fall chinook during the 1989 fall fishery while their total contribution to the inriver run (inriver fisheries, spawning ground surveys and hatchery returns) was only 36.8%. IGH CWTs accounted for 71.1% estimated harvest of CWT fall chinook in the Estuary Area and the harvest of IGH and TRH CWT fall chinook in the Middle and Upper Klamath Areas combined was equally divided (50:50).

Yearling CWT release groups continue to generally contribute to the gill net fishery at higher rates than fingerling release groups (Table 18). This is probably due to the increased survival rate of yearling releases.

The age composition of CWT chinook harvested on the YIR during the fall fishery in 1989 was 0.1% age 2, 5.5% age 3, 90.1% age 4, and 4.3% age 5 and 6 (Table 19). The age composition of CWT chinook using only fall CWT codes originating from within the Klamath Basin was 0.1% age 2, 4.7% age 3, 90.2% age 4, and 5.0 % age 5 and 6. The inriver run age composition of Klamath Basin CWT fall chinook (based on recoveries from hatcheries, spawning ground surveys, and inriver sport and Indian fisheries) was 4.1% age 2, 43.2% age 3, 50.6% age 4, and 2.2% age 5. The age composition of the inriver run of IGH fall chinook codes was 1.2% age 2, 4.9% age 3, 90.3% age 4, and 3.7% age 5. The age composition of the inriver run of TRH fall chinook codes was 5.8% age 2, 65.5% age 3, 27.4% age 4, and 2.2% age 5.

Comparison of the age composition of CWT chinook harvested in the Estuary Area during the commercial fishery, August 9 to August 30, and the age composition of fall chinook sampled by the USFWS beach seine operation during that same period indicates that there may have been a higher proportion of age 3 chinook in the estuary during the commercial fishery than was impacted by the gill net fishery. The beach seine data should be viewed with discretion because the gill net fishery is selective for age 4 chinook and the substantial impact that occurs on the 4-year-old component of the run during the intensive commercial gill net fishery could greatly affect the population structure that is available for the beach seine operation to sample. Disproportionate harvest of age 4 chinook would shift the age composition towards age 3 chinook. Another possible reason causing this discrepancy is that the CWT information is made up of predominately hatchery stocks while the beach seine data is a combination of hatchery and natural fish. Scale samples collected from chinook randomly sampled

TABLE 17. Origin and recovery area of expanded coded-wire tags (% of recovered tags in parentheses) harvested by the gill net fishery on the Yurok Indian Reservation in 1989.

	Monitoring Area			
	Estuary	Middle Klamath	Upper Klamath	Total
Iron Gate Hatchery	947.47 (38.6)	53.74 (29.8)	30.39 (23.2)	1,031.60 (37.3)
Iron Gate Hatchery Stock 1/	803.91 (32.7)	52.53 (29.2)	44.44 (33.9)	900.88 (32.6)
Iron Gate Hatchery Stock - HVBC 2/	254.85 (10.4)	19.93 (11.1)	13.18 (10.1)	287.96 (10.4)
Trinity River Hatchery - Fall Race	385.30 (15.7)	50.24 (27.9)	33.79 (25.8)	469.33 (17.0)
Trinity River Hatchery - Spring Race	21.73 (0.9)	0.00 (0.0)	0.00 (0.0)	21.73 (0.8)
Trinity River Stock 3/	1.42 (0.1)	0.00 (0.0)	0.00 (0.0)	1.42 (0.1)
Klamath Basin Wild 4/	27.84 (1.1)	0.00 (0.0)	0.00 (0.0)	27.84 (1.0)
Rogue River 5/	13.94 (0.6)	0.00 (0.0)	0.00 (0.0)	13.94 (0.5)
Trinity River Tributary Stocks 6/	0.00 (0.0)	3.76 (2.1)	9.14 (7.0)	12.90 (0.5)
Total Tags	2,456.46	180.20	130.94	2,767.60
No Tags	473.85	6.12	7.02	486.99
Total	2,930.31	186.32	137.96	3,254.59

1/ Iron Gate Hatchery (IGH) stock reared at offsite facilities and either released at those facilities or released at IGH

2/ Iron Gate Hatchery stock reared and released at Tish Tang Creek (Trinity River) by the Hoopa Valley Business Council's Fishery Department

3/ Trinity River Hatchery stock reared and released at Ambrose Pond

4/ Wild Stock Assessment Program - Bogus Creek and Shasta River stocks

5/ Rogue River stocks - Cole Rivers Hatchery and Indian Creek Ponds

6/ Trinity River Tributary stocks - Mill Creek and Supply Creek stocks reared and released at the Hoopa Valley Business Council Hatchery

TABLE 18. Contribution rate of CWT age 3 and 4 fall chinook to the Indian net fishery on the Yurok Indian Reservation in 1989.

Tag Code	Brood Year	Rearing1/ Facility	Release2/ Type	NUMBER HARVESTED3/ 3	4	Total	Number4/ Released Tagged	Contribution5/ Rate
06-59-23	1983	IGH	F	38	158	196	191,352	0.102
06-61-26	1983	TRH	F	87	35	122	191,094	0.064
06-56-08	1983	TRH	F6/	25	25	50	91,153	0.055
06-56-12	1983	TRH	F6/	80	18	98	97,311	0.101
06-56-13	1983	TRH	F6/	105	26	131	100,227	0.131
06-59-24	1983	IGH	F6/	80	92	172	97,566	0.176
06-59-25	1983	IGH	Y	25	903	928	94,738	0.980
06-59-26	1983	IGH	Y	34	291	325	23,725	1.370
06-59-31	1983	IGH	Y	0	173	173	22,599	0.766
06-59-32	1983	IGH	Y	10	185	195	24,830	0.785
06-59-33	1983	IGH	Y	0	257	257	23,766	1.081
06-61-13	1983	TRH	Y	62	143	205	100,520	0.204
06-56-14	1983	TRH	Y6/	0	18	18	25,547	0.071
06-56-15	1983	TRH	Y6/	26	15	41	25,754	0.159
06-56-16	1983	TRH	Y6/	0	17	17	26,171	0.065
06-63-01	1983	TRH	Y+	13	298	311	92,965	0.335
06-59-27	1984	IGH	F	37	181	218	187,500	0.116
06-59-28	1984	IGH	F	130	394	524	93,710	0.559
06-61-27	1984	TRH	F	135	37	172	189,708	0.091
06-56-17	1984	TRH	F6/	37	8	45	98,906	0.045
06-56-18	1984	TRH	F6/	39	13	52	98,989	0.053
06-56-19	1984	TRH	F6/	63	35	98	94,100	0.104
06-52-02	1984	HVBC	Y	2	27	29	1,909	1.519
06-59-22	1984	IGH	Y	53	511	564	98,500	0.573
06-61-28	1984	TRH	Y	36	93	129	97,070	0.133
06-56-20	1984	TRH	Y6/	42	26	68	30,459	0.223
06-56-21	1984	TRH	Y6/	15	28	43	24,541	0.175
06-56-22	1984	TRH	Y6/	9	49	58	25,450	0.228
06-59-35	1984	IGH	Y6/	5	81	86	24,275	0.354
06-56-24	1984	TRH	Y+	86	402	488	102,512	0.476
06-56-23	1985	TRH	F	84	112	196	196,249	0.010
06-59-34	1985	IGH	F	87	67	154	147,356	0.105
B6-08-05	1985	SRWILD	F	4	1	5	23,568	0.019
B6-08-06	1985	SRWILD	F	7	8	15	26,857	0.056
06-52-03	1985	HVBC	Y	-	9	9	101,091	0.009
06-52-04	1985	HVBC	Y	4	4	8	3,706	0.216
06-52-05	1985	HVBC	Y	143	288	431	26,505	1.626
06-56-25	1985	TRH	Y	101	280	381	97,368	0.391
06-59-29	1985	IGH	Y	33	714	747	95,296	0.784
06-63-02	1985	IGH7/	Y	5	17	22	15,720	0.140
06-63-03	1985	IGH7/	Y	11	154	165	18,875	0.874
06-63-04	1985	IGH7/	Y	5	99	104	16,038	0.648
06-63-05	1985	IGH7/	Y	11	99	110	16,038	0.686
06-63-06	1985	IGH7/	Y	6	125	131	21,225	0.617
06-63-07	1985	IGH7/	Y	3	123	126	21,225	0.594
06-63-08	1985	IGH7/	Y	4	92	96	18,126	0.530
06-63-09	1985	IGH7/	Y	12	173	185	17,596	1.051
06-63-18	1985	IGH	Y	14	98	112	24,443	0.458

1/ IGH - Iron Gate Hatchery
TRH - Trinity River Hatchery
HVBC - Hoopa Valley Business Council Hatchery
SRWILD - Wild Stock Assessment Program - Shasta River Stock

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to November release
Y+ (Yearling-Plus) - February release

3/ Estimated number of coded-wire tagged fall chinook

4/ From Pacific Marine Fisheries Commission CWT release data (PMFC 1988)

5/ Contribution rate = (estimated number harvested / number released tagged) X 100

6/ Off-site release

7/ Reared at Fall Creek - Klamath River - Released at IGH

Table 19. Percent age composition of the chinook gill net harvest (based on coded-wire tag recoveries) on the Yurok Indian Reservation in 1989 and beach seine age composition based on scale analysis.

	Age				
	2	3	4	5	6
All Areas	0.1	5.5	90.1	4.1	0.2
Upper Klamath	0.0	11.8	83.7	4.6	0.0
Middle Klamath	1.7	14.7	77.7	3.7	2.2
Estuary	0.0	4.2	91.7	4.1	0.1
Beach Seine	4.8	38.6	53.3	3.3	0.0
Estuary 1/					
Net Harvest - CWT's	0.0	4.0	91.0	4.9	0.1
Net Harvest - Scales	0.0	13.6	82.0	4.4	0.0
Beach Seine - Scales	2.4	23.8	68.9	4.9	0.0

1/ Age compostion based on samples collected during the commercial fishery (August 9 - 30) in the Estuary Area.

at the commercial buying station had an age composition of 13.6% age 3, 82.0% age 4, and 4.4% age 5. This age composition is very different from the age composition based on CWT recoveries. This suggests that the non-CWT chinook have a very different age composition that CWT chinook. This observation should be investigated further due to the use of CWT age composition data in the Klamath River basin cohort reconstruction. If the age composition based on CWT recoveries does not represent the age composition of the run, then the cohort analysis and reconstruction will misrepresent the actual structure and contribution of each cohort.

Length statistics by CWT code and area of capture are presented in Table 20.

The gill net fishery on the YIR continues to harvest IGH stocks and presumably Klamath natural stocks (assuming that they have similar run timing) at a higher rate than they occur in the run. The difference in run timing between the two hatchery stocks, the timing of the estuary fishery and the selectivity of the gill nets causes the disproportionate impacts between the Klamath and Trinity stocks.

As noted in previous annual reports (USFWS 1988, USFWS 1989), the intense Estuary Area gill net fishery that has developed with the creation a commercial fishery and the fact that the majority of the estuary harvest occurs in August has caused higher impacts on IGH stocks. IGH stocks enter the river predominately in July and August while TRH stocks enter the river in mid- to late August and September (based on the recovery of CWT data and fin clip data from the constant fractional marking program implemented in the early 1980's by CDFG).

Although the harvest of fall chinook in the Middle and Upper Klamath Areas occurred throughout the run which would presumably allow harvest impacts to occur in proportion to the relative abundance of Klamath and Trinity stocks, IGH hatchery stocks were impacted at a higher rate than they occurred in the inriver run. The harvest of CWT fall chinook was equally balanced between IGH and TRH but the majority (63.2%) of the inriver run of CWT fall chinook was from TRH. The difference in impacts in the Middle and Upper Klamath Areas can be attributed to the selectivity of the gill nets for 4-year-old and older chinook.

Until the timing of the commercial fishery is shifted to late August and mesh size regulations are implemented, the gill net fishery on the YIR will continue to over-harvest Klamath basin stocks and 4-year-old chinook from both the Klamath and Trinity River system. Changing only the timing of the Estuary Area fishery will only partially address the difference of impacts on Klamath and Trinity basin stocks. Impacts will continue to be unbalanced towards IGH stocks due to the high proportion of age 3 chinook in the Trinity River run and the selectivity of the gill nets for age 4 and older chinook.

Spring Fishery

Sixty CWTs were recovered from 65 snouts collected from AD-clipped chinook salmon sampled during the spring fishery (April through July 15) on the YIR. An estimated 634 CWT spring chinook, 2 CWT fall chinook and 47 AD-clipped chinook that did not contain a CWT were harvested during the spring fishery (Table 21). All 6 tag codes originated from TRH; 1 yearling fall chinook release group and 2 fingerling and 3 yearling spring chinook release groups.

The majority (85.4%) of the CWT chinook harvested during the spring fishery were 4-year-old chinook from a yearling release group (code 06-61-44). The age composition of CWT spring chinook harvested during the spring fishery was 4.1% age 3, 95.5% age 4 and 0.4% age 5. The contribution rate of age 3 and 4 yearling releases of spring chinook to the gill net fishery has shown a steady increase over the past 5 completed broods (1981 - 1985) (Table 22).

Length statistics by CWT code and area of capture are presented in Table 23.

TABLE 20. Length data of chinook coded wire tag groups harvested during the spring fishery (July 16 - October 22) on the Yurok Indian Reservation in 1989.

Tag Code	Brood Year	Race	Hatchery1/ of Origin	Release2/ Type	RESERVATION MONITORING AREA Estuary	Middle Klamath	Upper Klamath	All Areas
06-52-03	1985	Fall	HVBC3/	Y	---4/ ---5/ 0 6/ ---7/ ---8/	--- --- 0 --- ---	81.7 6.7 3 76 89	81.7 6.7 3 76 89
06-52-04	1985	Fall	HVBC9/	Y	--- --- 0 --- ---	78.0 --- 1 78 78	--- --- 0 --- ---	78.0 --- 1 78 78
06-52-05	1985	Fall	HVBC10/	Y	79.7 5.4 141 61 99	81.7 3.4 6 78 87	78.8 3.1 4 76 83	79.7 5.3 151 61 99
06-53-01	1986	Fall	IGH11/	Y	--- --- 0 --- ---	70.0 --- 1 70 70	71.2 3.6 5 65 74	71.0 3.3 6 65 74
06-56-22	1984	Fall	TRH	Y	77.0 2.8 2 75 79	--- --- 0 --- ---	--- --- 0 --- ---	77.0 2.8 2 75 79
06-56-23	1985	Fall	TRH	F	77.6 3.8 49 69 85	81.0 3.6 3 78 85	77.5 5.0 2 74 81	77.8 3.8 54 69 85
06-56-24	1984	Fall	TRH	Y+	75.5 4.9 8 70 85	--- --- 0 --- ---	87.5 7.8 2 82 93	79.5 6.6 10 70 93
06-56-25	1985	Fall	TRH	Y	77.1 4.5 126 67 94	77.5 5.9 8 71 89	75.0 2.7 4 71 77	77.0 4.5 138 67 94
06-56-27	1986	Fall	TRH	Y	69.5 5.1 13 63 77	69.3 2.1 3 67 71	68.3 1.5 3 67 70	69.3 4.3 19 63 77
06-56-28	1986	Fall	TRH	Y	70.5 0.7 2 70 71	66.0 --- 1 66 66	--- --- 0 --- ---	69.0 2.6 3 66 71
06-56-30	1986	Fall	TRH	F12/	62.0 --- 1 62 62	--- --- 0 --- ---	--- --- 0 --- ---	62.0 --- 1 62 62
06-59-22	1984	Fall	IGH	F	83.7 5.5 14 76 94	--- --- 0 --- ---	--- --- 0 --- ---	83.7 5.5 14 76 94
06-59-25	1983	Fall	IGH	Y	--- --- 0 --- ---	78.0 --- 1 78 78	--- --- 0 --- ---	78.0 --- 1 78 78

TABLE 20. (Continued)
Length data of chinook coded wire tag groups harvested during the spring fishery (July 16 - October 22) on the Yurok Indian Reservation in 1989.

Tag Code	Brood Year	Race	Hatchery1/ of Origin	Release2/ Type	RESERVATION MONITORING AREA Estuary	Middle Klamath	Upper Klamath	All Areas
06-59-27	1984	Fall	IGH	F	82.9	---	79.0	82.7
					7.0	---	---	6.9
					20	0	1	21
					72	---	79	72
					92	---	79	92
06-59-28	1984	Fall	IGH	F	82.2	88.0	---	83.3
					4.0	7.1	---	4.8
					9	2	0	11
					78	83	---	78
					87	93	---	93
06-59-28	1984	Fall	IGH	F	82.2	88.0	---	83.3
					4.0	7.1	---	4.8
					9	2	0	11
					78	83	---	78
					87	93	---	93
06-59-29	1985	Fall	IGH	Y	78.8	77.5	73.5	78.7
					5.3	3.0	5.5	5.3
					381	4	4	389
					64	74	66	64
					94	80	79	94
06-59-34	1985	Fall	IGH	F	80.4	81.0	92.0	80.8
					4.6	---	---	4.8
					32	1	1	34
					73	81	92	73
					92	81	92	92
06-59-35	1984	Fall	IGH	Y	81.3	---	82.0	81.5
					4.0	---	---	3.3
					3	0	1	4
					77	---	82	77
					85	---	82	85
06-59-36	1987	Fall	IGH	Y	---	51.0	---	51.0
	2				---	---	---	---
					0	1	0	1
					---	51	---	51
					---	51	---	51
06-59-42	1986	Fall	IGH	Y	66.5	---	---	66.5
					2.1	---	---	2.1
					2	0	0	2
					65	---	---	65
					68	---	---	68
06-59-60	1986	Fall	IGH	F	68.8	75.0	---	70.8
					2.2	2.8	---	3.9
					4	2	0	6
					66	73	---	66
					71	77	---	77
06-61-27	1984	Fall	TRH	F	81.0	---	---	81.0
					---	---	---	---
					1	0	0	1
					81	---	---	81
					81	---	---	81
06-61-28	1984	Fall	TRH	Y	83.0	---	---	83.0
					1.4	---	---	1.4
					2	0	0	2
					82	---	---	82
					84	---	---	84
06-61-43	1984	Spring	TRH	Y	80.0	---	---	80.0
					---	---	---	---
					1	0	0	1
					80	---	---	80
					80	---	---	80

TABLE 20. (Continued)
Length data of chinook coded wire tag groups harvested during the spring fishery (July 16 - October 22) on the Yurok Indian Reservation in 1989.

Tag Code	Brood Year	Race	Hatchery1/ of Origin	Release2/ Type	RESERVATION MONITORING AREA Estuary	Middle Klamath	Upper Klamath	All Areas
06-61-44	1985	Spring	TRH	Y	78.0	---	---	78.0
					---	---	---	---
					1	0	0	1
					78	---	---	78
					78	---	---	78
06-61-46	1986	Spring	TRH	Y	68.9	---	---	68.9
					5.9	---	---	5.9
					8	0	0	8
					63	---	---	63
					81	---	---	81
06-63-02	1985	Fall	IGH13/	Y	79.3	---	---	79.3
					5.5	---	---	5.5
					10	0	0	10
					70	---	---	70
					89	---	---	89
06-63-03	1985	Fall	IGH13/	Y	79.1	83.3	76.5	79.3
					4.9	5.4	0.7	5.0
					73	4	2	79
					69	76	76	69
					97	89	77	97
06-63-04	1985	Fall	IGH13/	Y	78.1	82.3	77.0	78.3
					4.8	2.5	---	4.8
					48	3	1	52
					66	80	77	66
					87	85	77	87
06-63-05	1985	Fall	IGH13/	Y	78.6	---	---	78.6
					5.4	---	---	5.4
					56	0	0	56
					68	---	---	68
					92	---	---	92
06-63-06	1985	Fall	IGH13/	Y	78.9	81.5	80.3	79.0
					4.9	3.5	2.5	4.8
					61	2	3	66
					71	79	78	71
					92	84	83	92
06-63-07	1985	Fall	IGH13/	Y	79.0	78.0	75.5	78.9
					4.9	7.1	0.7	4.9
					68	2	2	72
					72	73	75	72
					93	83	76	93
06-63-08	1985	Fall	IGH13/	Y	77.7	77.5	---	77.7
					4.6	2.1	---	4.6
					50	2	0	52
					66	76	---	66
					87	79	---	87
06-63-09	1985	Fall	IGH13/	Y	78.9	---	72.0	78.9
					5.0	---	---	5.0
					99	0	1	100
					69	---	72	69
					92	---	72	92
06-63-18	1985	Fall	IGH	Y	78.7	82.0	88.0	79.0
					5.1	2.8	---	5.1
					49	2	1	52
					66	80	88	66
					89	84	88	89
06-63-32	1986	Fall	IGH	Y	70.3	66.0	68.0	69.8
					4.1	---	4.2	4.0
					16	1	2	19
					64	66	65	64
					78	66	71	78

TABLE 20. (Continued)
Length data of chinook coded wire tag groups harvested during the spring fishery (July 16 - October 22) on the Yurok Indian Reservation in 1989.

					RESERVATION MONITORING AREA			
Tag Code	Brood Year	Race	Hatchery1/ of Origin	Release2/ Type	Estuary	Middle Klamath	Upper Klamath	All Areas
07-35-41	1985	Fall	CRH	Y	80.6	---	---	80.6
					6.4	---	---	6.4
					5	0	0	5
					73	---	---	73
					88	---	---	88
07-35-43	1985	Fall	ICP	Y	80.0	---	---	80.0
					---	---	---	---
					1	0	0	1
					80	---	---	80
					80	---	---	80
86-08-02	1983	Fall	BCWILD	F	72.0	---	---	72.0
					---	---	---	---
					1	0	0	1
					72	---	---	72
					72	---	---	72
86-08-05	1985	Fall	SRWILD	F	78.0	---	---	78.0
					---	---	---	---
					1	0	0	1
					78	---	---	78
					78	---	---	78
86-08-06	1985	Fall	SRWILD	F	79.2	---	---	79.2
					1.9	---	---	1.9
					5	0	0	5
					76	---	---	76
					81	---	---	81
86-08-10	1986	Fall	SRWILD	F	71.1	---	---	71.1
					3.9	---	---	3.9
					7	0	0	7
					66	---	---	66
					76	---	---	76
86-09-01	1986	Fall	BCWILD	F	74.7	---	---	74.7
					2.3	---	---	2.3
					3	0	0	3
					72	---	---	72
					76	---	---	76
AD-NO TAG					78.6	73.5	80.0	78.6
					5.4	3.5	1.4	5.4
					270	2	2	274
					64	71	79	64
					98	76	81	98

1/ BCWILD - Wild Stock Assessment Program - Bogus Creek
CRH - Cole Rivers Hatchery
HVBC - Hoopa Valley Business Council
ICP - Indian Creek Ponds - Rogue River
IGH - Iron Gate Hatchery
SRWILD - Wild Stock Assessment Program - Shasta River
TRH - Trinity River Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to December release
Y+ (Yearling-Plus) - February or later release

3/ Supply Creek Stock - Trinity River
4/ Mean fork length (cm)
5/ Standard deviation (cm)
6/ Sample size
7/ Minimum size (cm)
8/ Maximum size (cm)
9/ Mill Creek Stock - Trinity River
10/ IGH Stock, reared and released at Tish Tang Creek - Trinity River
11/ Reared and released at Cappell Creek - Klamath River
12/ Reared and released at Ambrose Pond - Trinity River
13/ Reared at Fall Creek - Klamath River - released at IGH

TABLE 21. Actual and expanded coded-wire tag recoveries for chinook salmon from the spring fishery (April 4 - July 15) on the Yurok Indian Reservation in 1989.

Tag Code	Brood Year	Race	Hatchery[1/] of Origin	Release[2/] Type	RESERVATION MONITORING AREA							
					Estuary		Middle Klamath		Upper Klamath		All Areas	
06-56-25	1985	Fall	TRH	Y	1	2.17	0	0.00	0	0.00	1	2.17
06-61-42	1985	Spring	TRH	F	0	0.00	4	62.48	0	0.00	4	62.48
06-61-43	1984	Spring	TRH	Y	1	2.83	0	0.00	0	0.00	1	2.83
06-61-44	1985	Spring	TRH	Y	18	29.34	20	375.34	10	138.53	48	543.21
06-61-45	1986	Spring	TRH	F	1	2.83	0	0.00	0	0.00	1	2.83
06-61-46	1986	Spring	TRH	Y	4	7.30	1	15.62	0	0.00	5	22.92
TOTAL TAGS					25	44.47	25	453.44	10	138.53	60	636.44
NO TAGS					2	2.50	2	31.24	1	12.77	5	46.51
TOTAL					27	46.97	27	484.68	11	151.30	65	682.95

1/ TRH - Trinity River Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to December release

TABLE 22. Contribution rate of CWT age 3 and 4 spring chinook for brood years 1978-1985 to the gill net fishery on the Yurok Indian Reservation.

Tag Code	Brood Year	Rearing1/ Facility	Release2/ Type	NUMBER HARVESTED3/ 3	4	Total	Number4/ Released Tagged	Contribution5/ Rate
06-61-11	1978	TRH	F6/	163	47	210	192,800	0.109
06-61-12	1978	TRH	F	69	11	80	170,800	0.047
06-61-30	1978	TRH	Y	126	541	667	191,916	0.348
06-61-31	1978	TRH	Y+	25	351	376	134,948	0.279
06-61-32	1979	TRH	F	0	15	15	187,494	0.008
06-61-33	1979	TRH	F6/	40	73	113	181,134	0.062
06-61-34	1979	TRH	Y	44	30	73	86,594	0.084
06-61-36	1979	TRH	Y+	0	10	10	35,666	0.028
06-61-39	1980	TRH	Y	10	39	49	34,601	0.142
06-61-35	1981	TRH	F	0	0	0	182,635	0.000
06-61-37	1981	TRH	Y	9	73	82	98,637	0.083
06-61-38	1982	TRH	Y	76	50	126	96,461	0.131
06-61-41	1982	TRH	F	6	12	18	146,194	0.012
06-61-40	1983	TRH	Y	96	224	320	90,293	0.354
06-61-43	1984	TRH	Y	207	230	437	98,568	0.443
06-61-42	1985	TRH	F	47	62	109	192,487	0.057
06-61-44	1985	TRH	Y	83	543	626	101,091	0.619

1/ TRH - Trinity River Hatchery

2/ F (Fingerling) - May or June release

Y (Yearling) - Late September to November release

Y+ (Yearling-Plus) - March release

3/ Estimated number of coded-wire tagged spring chinook

4/ From Pacific Marine Fisheries Commission CWT release data (PMFC 1985)

5/ Contribution rate = numbe, harvested / number released tagged X 100

6/ Off-site release at Trinity River kilometer 40.0 (Willow Creek)

TABLE 23. Length data of chinook coded-wire tag groups harvested during the spring fishery (April 4 through July 15) on the Yurok Indian Reservation in 1989.

Tag Code	Brood Year	Race	Hatchery1/ of Origin	Release2/ Type	MONITORING AREA			
					Estuary	Middle Klamath	Upper Klamath	All Areas
06-56-25	1985	Fall	TRH	Y	78.0 3/	---	---	78.0
					--- 4/	---	---	---
					1 5/	0	0	1
					78 6/	---	---	78
					78 7/	0	0	78
06-61-42	1985	Spring	TRH	F	---	70.5	---	70.5
					---	5.0	---	5.0
					0	4	0	4
					---	64	---	64
					---	76	---	76
06-61-43	1984	Spring	TRH	Y	81.0	---	---	81.0
					---	---	---	---
					1	0	0	1
					81	---	---	81
					81	---	---	81
06-61-44	1985	Spring	TRH	Y	74.1	69.3	75.7	72.4
					4.9	16.8	5.1	11.6
					18	20	10	48
					68	66	68	66
					88	80	84	88
06-61-45	1986	Spring	TRH	F	70.0	---	---	70.0
					---	---	---	---
					1	0	0	1
					70	---	---	70
					70	---	---	70
06-61-46	1986	Spring	TRH	Y	64.8	64.0	---	64.6
					5.1	---	---	4.5
					4	1	0	5
					58	64	---	58
					70	64	---	70
AD-NO TAG					68.5	77.5	74.0	73.2
					12.0	13.4	---	10.1
					2	2	1	5
					60	68	74	60
					77	87	74	87

1/ TRH - Trinity River Hatchery

2/ F (Fingerling) - May or June release
Y (Yearling) - Late September to December release

3/ Mean fork length (cm)

4/ Standard deviation

5/ Sample size

6/ Minimum size (cm)

7/ Maximum size (cm)

OTHER SPECIES

The beach seining and net harvest monitoring programs also encountered coho salmon, steelhead trout, sturgeon, and American shad (Alosa sapidissima). These species were sampled in the manner previously described for the beach seining and net harvest monitoring programs. Although these programs focus primarily on chinook salmon, other species are encountered, often in substantial numbers to warrant presentation of their catch statistics and other biological attributes.

The seining efforts were concluded prior to the run completion of most of the listed species. Additionally, the seining gear and methods employed were selected to favor capture of chinook salmon, and as such may not be optimal for capturing other species. Coho and steelhead are not target species for the Indian net fishery and their harvest is generally considered incidental to that of spring and fall chinook salmon, and sturgeon. These incidental data may not be representative of their various life histories.

These species are all valuable and utilized for subsistence, commercial sport harvest. However, relatively little is known regarding their life histories, limiting factors, and populational status. This information is needed to insure long-term utilization of these species.

A species list of documented fish captures within the Klamath River estuary is presented at the end of this section (Table 24). This updated list incorporates reliable observations of various species seen since 1979.

METHODS

Methods used in collecting and analyzing beach seine and net harvest data from coho, steelhead and sturgeon are the same as previously described for chinook salmon. However, age analyses were not performed on steelhead and sturgeon. Any separation by life history stage was on length frequencies and may not be a true indication of age composition. Sturgeon were measured to total length, and those captured in the beach seine were implanted with spaghetti tags prior to release. All other species were counted and measured prior to release. Statistical analyses of data was limited to the t-test unless otherwise noted. The data were compared at the 95% confidence level.

RESULTS AND DISCUSSION

Coho Salmon

Beach Seining

Seven coho salmon were captured during the seining season. The first coho was captured on September 8, 1989. The coho averaged 66.0 cm (s=3.63, n=7) in length, and the size range was 61 cm to 73 cm. All coho were three-year-olds. The seining operation concluded prior to the end of the 1989 coho run. In the three previous seasons (1986-1988), 63, 115, and 19 coho were captured.

Table 24. Fish species observed in the Klamath River estuary, 1979-1989, relative abundance (#1), and method(s) of capture (#2-7).

	1	2	3	4	5	6	7
PETROMYZONTIDAE							
Pacific lamprey (*Lampetra tridentata*)	C	X	X		X	X	X
river lamprey (*Lampetra ayresi*)	R					X	
CARCHARHINIDAE							
white shark (*Carcharodon carcharias*)	R	X					
SQUALIDAE							
spiny dogfish (*Squalas acanthias*)	R	X					
RAJIDAE							
big skate (*Raja binoculata*)	R	X					
ACIPENSERIDAE							
green sturgeon (*Acipenser medirostris*)	C	X	X	X	X	X	X
white sturgeon (*Acipenser transmontanus*)	U	X	X				
CLUPEIDAE							
American shad (*Alosa sapidissima*)	C	X	X	X	X	X	X
Pacific herring (*Clupea harengus*)	U		X	X			
ENGRAULIDAE							
northern anchovy (*Engraulis mordax*)	U			X			
SALMONIDAE							
chinook salmon (*Onchorhynchus tshawytscha*)	C	X	X	X	X	X	X
coho salmon (*Onchorhynchus kisutch*)	C	X	X	X	X	X	X
pink salmon (*Onchorhynchus gorbuscha*)	U	X	X				
chum salmon (*Onchorhynchus keta*)	U	X					
rainbow trout (*Onchorhynchus mykiss*)	C	X	X	X	X	X	X
cutthroat trout (*Onchorhynchus clarki*)	C	X	X	X	X	X	X
brown trout (*Salmo trutta*)	U	X	X				
OSMERIDAE							
longfin smelt (*Spirinchus thaleichthys*)	C			X	X	X	X
surf smelt (*Hypomesus pretiosis*)	U			X	X	X	X
eulachon (*Thaleichthyes pacificus*)	U					X	X
CYPRINIDAE							
speckled dace (*Rhinichthys osculus*)	U						X
golden shiner (*Notemigonus crysoleucas*)	R			X			X
CATOSTOMIDAE							
Klamath smallscale sucker (*Catostomus rimiculus*)	C			X	X	X	X

Table 24. (Continued)
Fish species observed in the Klamath River estuary, 1979-1989, relative abundance (#1), and method(s) of capture (#2-7).

	1	2	3	4	5	6	7
GADIDAE							
Pacific hake (*Merluccius productus*)	R	X	X				
Pacific tomcod (*Microgadus proximus*)	R					X	
ATHERINIDAE							
jacksmelt (*Atherinopsis californiensis*)	U					X	
topsmelt (*Atherinops affinis*)	U			X			
GASTEROSTEIDAE							
threespine stickleback (*Gasterosteus aculeatus*)	C			X	X	X	X
SYNGNATHIDAE							
bay pipefish (*Syngnathus leptorhynchus*)	R	X	X				
PERCICHTHYIDAE							
striped bass (*Morone saxatilis*)	R	X					
yellow perch (*Perca flavescens*)	R						X
CENTRARCHIDAE							
green sunfish (*Lepomis cyanellus*)	R			X			
black crappie (*Pomoxis nigromaculatus*)	R						X
KYPHOSIDAE							
zebra perch (*Hermosilla azurea*)	R		X				
EMBIOTOCIDAE							
redtail surfperch (*Amphistichus rhodoterus*)	C	X	X	X			X
walleye surfperch (*Hyperprosopon argenteum*)	R		X				
shiner surfperch (*Cymatogaster aggregata*)	C		X	X	X	X	X
striped surfperch (*Embiotoca lateralis*)	R						
PHOLIDAE							
saddleback gunnel (*Pholis ornata*)	R			X			
COTTIDAE							
staghorn sculpin (*Leptocottus armatus*)	C			X	X		X
prickly sculpin (*Cottus asper*)	U		X	X	X	X	

Table 24. (Continued)
Fish species observed in the Klamath River estuary, 1979-1989, relative abundance (#1), and method(s) of capture (#2-7).

	1	2	3	4	5	6	7
PLEURONECTIDAE							
butter sole (Isopsetta isolepis)	U		X				X
starry flounder (Platichthys stellatus)	C	X	X	X	X		X
speckled sanddab (Citharichthys stigmaeus)	R		X				

1 Occurrence: C=common, seen annually U=uncommon, not seen annually. R=rare, 3 or less sightings during the past decade.

2 Gill Nets: Variable net dimensions and mesh sizes.

3 Beach Seine: 152.5 meters by 6.1 meters, 4.4 bar mesh (1979-1988), 152.5 m x 6.1 m, 3.2 cm bar mesh bag (1989).

4 Juvenile Seine: 30.5 m x 1.8 m, 0.6 cm mesh.

5 Push Net: 1.8 m x 1.8 m, 0.6 cm mesh (USFWS, 1982a).

6 Trawl: 6.7 m2 mouth, 0.6 cm mesh (USFWS, 1981a)

7 CDFG: Electrofishing and various gear.

Net Harvest

An estimated 525 (14 jacks and 511 adults) coho salmon were harvested on the YIR in 1989. Estimated harvest by area was 0, 277, and 248 for the Estuary, Middle Klamath, and Upper Klamath areas, respectively.

Ad-clips were observed on 11 (5.5%) of the 200 coho salmon examined. All 11 CWT recoveries were from the code 06-56-56 release group. These fish were from a yearling-plus release from the Sawmill Ponds rearing facility on the Trinity River. An estimated 29 coho salmon from CWT code 06-56-56 were harvested on the YIR by the 1989 gill net fishery.

The mean fork length of adult coho salmon harvested by the gill net fishery in 1989 was 69.0 cm (s=3.74, n=166)(Figure 17). The mean length of jacks was 55.6 cm (s=1.14, n=5). The mean length of ad-clipped coho was 68.1 cm (s=2.51, n=11).

The majority (99.2%) of the coho salmon were captured after Sept. 11. The peak weekly harvest in the Middle Klamath area was 140 coho salmon during Sept. 18-24. The peak weekly harvest in the Upper Klamath area (112 coho), occurred during the week of October 2-8. The estimated harvest of coho salmon on the YIR during the 1989 gill net fishery is not a complete assessment of the gill net harvest of coho salmon. In the Upper Klamath area, harvest monitoring was discontinued on October 22 and the estimated coho harvest for that week was 53 salmon. The harvest of coho salmon probably continued after harvest monitoring activities were ended.

Steelhead Trout

Beach Seining

A total of 637 steelhead trout were captured in 304 seine hauls. This catch consisted of 474 non-adult (<41 cm), and 109 adults (>41 cm); the remaining 54 steelhead consisted of 16 recaptures, and 38 steelhead that were released without examination.

Non-adult steelhead averaged 30.7 cm in length, versus 53.5 cm for adults. The smallest steelhead measured 21 cm, the largest, 68 cm. The size of non-adults was significantly ($p<0.05$) smaller than half-pounders of the past four seasons (Figure 18). This resulted from use of a different seine than in previous years. The smaller mesh (3.2 cm bar bag section) of this year's seine captured 230 steelhead less than 31 cm; these smaller steelhead were less vulnerable to capture during previous seasons. The smallest steelhead captured last season measured 31 cm.

Scale analyses of steelhead trout collected in previous years by CDFG indicated that the smallest half-pounder returning from the ocean into freshwater was 25 cm (J. Hopelain, CDFG 1989 personal communication). Based on this criteria, 467 (98.5%) of the total 474 non-adult steelhead could be

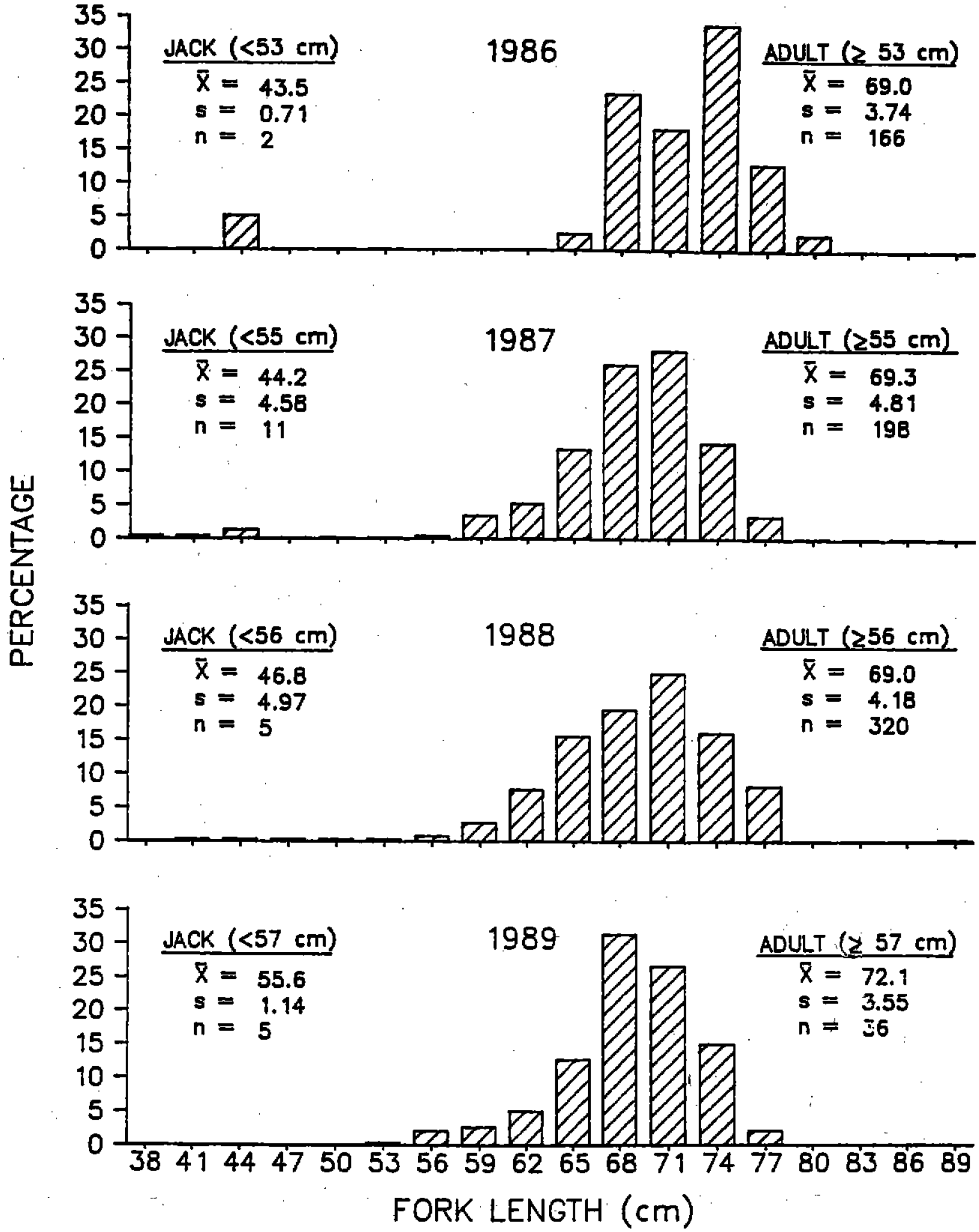

FIGURE 17. Length frequency distributions of coho salmon harvested by gill net fishers on the Yurok Indian Reservation during 1986-1989.

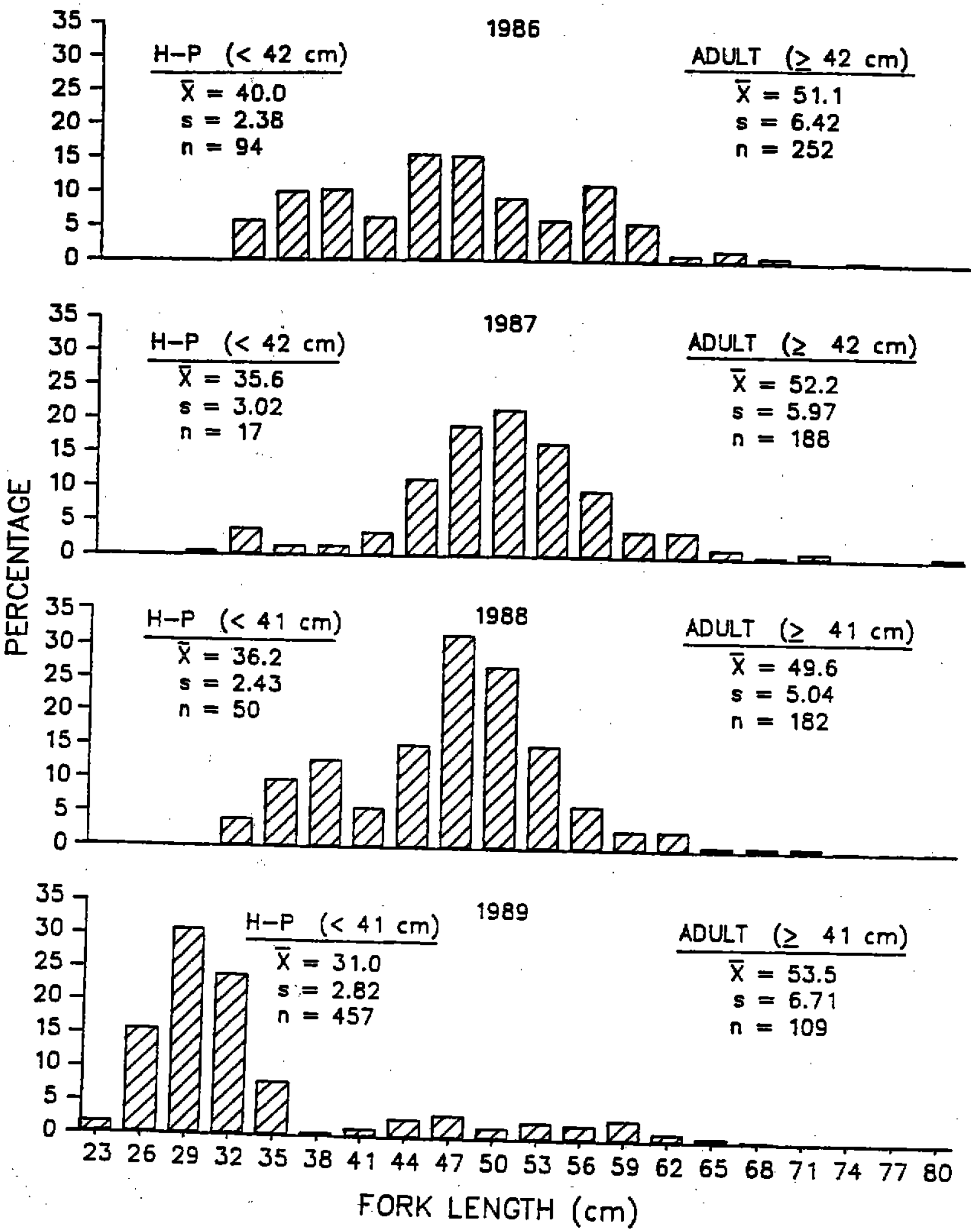

FIGURE 18. Length frequency distributions of steelhead trout captured during beach seine operations in the Klamath River estuary during 1986-1989.

categorized as a "half-pounders". The remaining 7 non-adults were less than 25 cm in length. The mean size of the 467 steelhead ("half-pounders" only) was 30.9 cm).

Adult steelhead were larger ($p<0.05$) than adults from the 1988 and 1986 seasons, whereas in 1987 and 1985, there were no differences ($p<0.05$) in size. The peak catch (138) day was September 7, and coincided with the weekly peak catch (258) during September 4-8, 1989.

Net Harvest

An estimated 219 steelhead trout (8 half-pounders (<41 cm), and 211 adults) were harvested by the gill net fishery on the YIR during the 1989 fall fishery. The majority of the harvest (76.7%) occurred in the Middle and Upper Klamath areas from September 16 to October 15. Estimated harvest of steelhead by area was 2, 117, and 100 for the Estuary, Middle Klamath, and Upper Klamath areas, respectively.

The mean length of adult steelhead harvested by the gill net fishery on the YIR in 1989 was 62.0 cm ($s=7.85$, $n=50$)(Figure 19). The mean length of half-pounders harvested was 33.3 cm ($s=0.58$, $n=3$).

Sturgeon

Beach Seining

One green sturgeon, measuring 97 cm fork length (107 cm total length) was captured on August 4. White sturgeon were not captured. The significance of the low catches of sturgeon during the past four seasons (2, 16, 1, 1), respectively, is unknown. Most of these captures have been juveniles, and it is unknown whether these are downstream migrants, estuary residents, or sturgeon that have entered the estuary to feed.

The seining sites are selected to target chinook salmon, and these sites (except 1987) apparently have not favored the capture of sturgeon. The 1987 seine site produced 15 green sturgeon and 1 white sturgeon. In contrast to sites of this (1989) and other seasons, the 1987 site was not situated directly in the channel of the mouth, but was aligned more in the body of the estuary (see Annual Report, 1987). Therefore, the seine results may not reflect the actual abundance of sturgeon in the estuary.

Net Harvest

An estimated 268 adult green sturgeon (>130 cm total length) were harvested on the YIR in 1989. The majority of the harvest, 95.5%, occurred during the spring fishery (April- July). The estimated harvest of green sturgeon by area was 131, 94, and 43 for the Upper Klamath, Middle Klamath, and Estuary Areas, respectively.

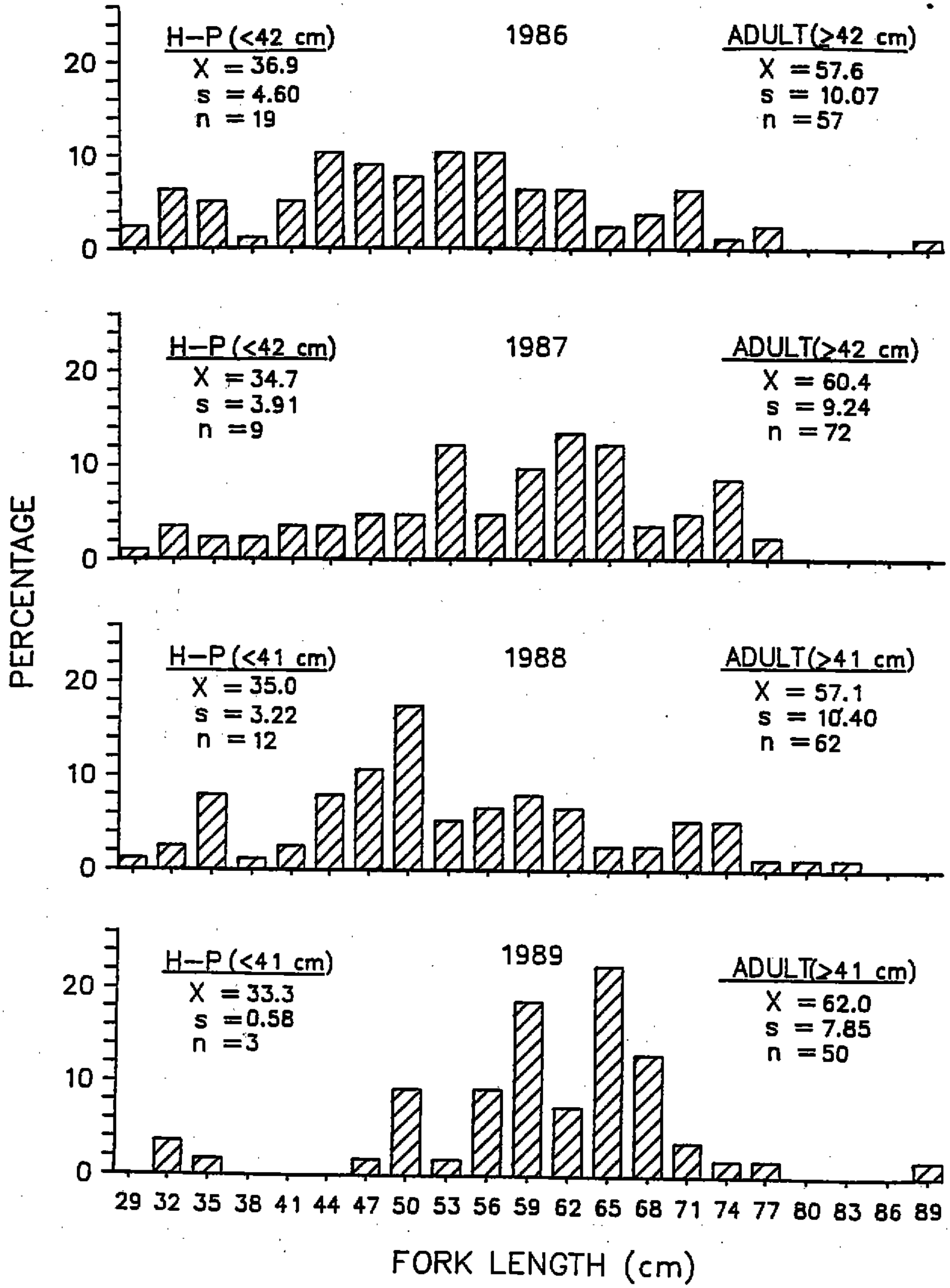

FIGURE 19. Length frequency distributions of steelhead trout harvested by gill net fishers on the Yurok Indian Reservation during 1986-1989.

The average total length of green sturgeon harvested on the YIR in 1989 was 169.5 cm (s=20.05, n=20)(Figure 20).

An estimated 34 white sturgeon were harvested on the YIR in 1989. The average total length was 153.5 (s=50.99, n=4).

Cutthroat Trout

Beach Seining

Fifteen cutthroat trout (Oncorhynchus clarki) were captured in the beach seine. These trout averaged 28.9 cm in length; the range was 26 cm to 32 cm. All cutthroat were captured during September, with eleven captures occurring on or after September 11, which may suggest either seasonal entry into the estuary, or movement of cutthroat into the lower estuary from upstream areas.

American Shad

Beach Seining

An estimated 895 adult American shad were captured throughout the seining season. The first shad was captured on July 25, the last on September 18, 1989. In July, 468 shad were seined, 326 during August, and 101 in September. The largest single haul occurred on July 25, when 400 (estimate) shad were captured.

Shad captures for the 1985-1988 seasons were 3,933, 3,155, 718, and 1,431, respectively.

Pacific Herring

Beach Seining

On August 2, 16 Pacific herring (Clupea harengus) were captured in the first two seine hauls of the day. During this time, diving birds (pelicans, terns, cormorants) were engaged in frenzied feeding activity within the mouth area. These birds were probably feeding upon a school of herring that entered the estuary. This is the first season that Pacific herring have been captured in the beach seine.

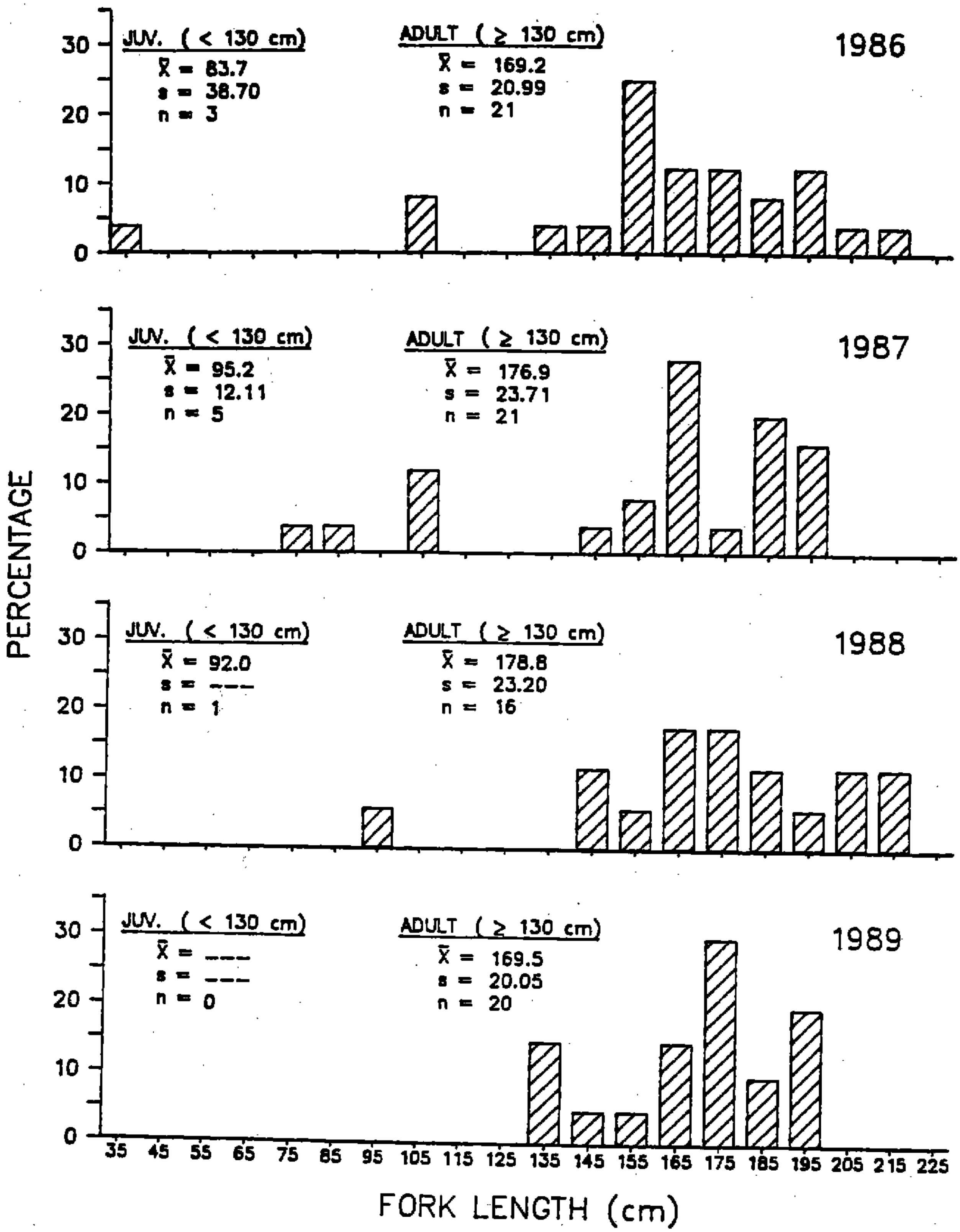

FIGURE 20. Length frequency distributions of green sturgeon harvested by gill net fishers on the Yurok Indian Reservation during 1986-1989.

PROGRAM PLANNING

INTRODUCTION

The primary responsibilities of CCFRO, Arcata are to provide technical assistance and fishery expertise in the management of fishery resources. This is accomplished by conducting various specialized field programs which address specific problems as they are identified, while maintaining the ability to conduct longer term monitoring programs such as are reported here.

The course of the Klamath River Fisheries Assessment Program (KRFAP) and the role of CCFRO, Arcata in addressing resource related issues involving the Klamath River basin evolved in response to Departmental direction through Memoranda of Agreement, Critical Issues Management System, and the FWS Management By Objectives Program. Further direction was received through a Statement of Responsibilities and Role (USFWS 1985) of the Fishery Resource Program. BIA planning processes involving the fishery resources of the YIR continue to greatly influence Program direction.

The KRFAP was initiated through the FWS in 1977 at the request of the BIA in order to provide data necessary for the management of the Klamath River fishery resources. The FWS was selected for Program initiation because of its recognized expertise in fisheries management, there being no such capacity within the BIA or the local Indian groups at that time. When a fisheries program is developed on the YIR, similar as to what occurred with the formation of the Hoopa Valley Reservation Fisheries Department, part or all of existing CCFRO, Arcata programs will be transferred to this organization.

PLANNING

Anadromous fishes of the Klamath-Trinity basin have been recognized as a high priority resource and have been identified as species deserving of restoration efforts. The KRFAP will continue to focus on five of these stocks: fall chinook salmon, spring chinook salmon, steelhead trout, coho salmon, and green scurgeon. These priority species and races fit the criteria of being depressed stocks, largely of natural origin, with high value to fisheries and good restoration potential. For these species and races, CCFRO, Arcata will continue to focus on : (1) collection of baseline information on population characteristics, (2) monitoring annual adult spawning migrations, (3) monitoring in-river net harvest levels, (4) analysis and presentation of information in a timely manner to those agencies responsible for managing these resources, and (5) providing technical assistance to the Klamath River Fishery Management Council and the Pacific Fishery Management Council. CCFRO, Arcata programs will be conducted to the extent possible in cooperation with other agencies involved with the management of the Klamath River fishery resources.

Specific directions anticipated for CCFRO, Arcata field activities in the future are as follows:

(1) Beach Seining Operations provide age composition data for hatchery and natural fall chinook as they enter the Klamath River. Given the selectivity of the inriver Indian and sport fisheries this data should represent the least

biased estimate of the age composition of the inriver run. The challenge facing this office's beach seining effort is to account for the biases that exist in the data given the changes in harvest patterns and to address concerns of the contributions of natural and hatchery fall chinook to the inriver run. Age composition and run timing data is extremely important to the management of this stock and efforts to increase the usefulness of the beach seine data and develop new data sources must continue.

(2) Harvest Monitoring Operations provide the only available estimates of spring and fall chinook, steelhead trout, and sturgeon by the Indian gill net fisheries on the YIR. Chinook salmon estimates are provided to CDFG to assist them in determining the annual Klamath River run sizes of these stocks. Collection of baseline biological data and coded-wire tag information from the gill net fishery on the YIR will continue. This information is important in assessing the impacts of the gill net fishery on the Klamath River stocks and their future management.

(3) Technical Assistance will be provided to the Department of Interior, Pacific Fisheries Management Council, Klamath River Fisheries Management Council, and the Bureau of Indian Affairs on matters concerning Klamath River fisheries management and Federal resource issues in Northern California. The majority of this assistance involves the analysis of data collected by agencies working within the Klamath-Trinity basin and making fishery management recommendations based on the best available data.

Program planning, direction, and coordination will remain essential and ongoing parts of CCFRO, Arcata activities. Program coordination and information dissemination to other agencies and groups involved in the Klamath-Trinity basin fishery resources are recognized as high priorities. Frequent meetings will continue to be held with biologists representing the Bureau of Indian Affairs, California Department of Fish and Game, U.S. Forest Service, Hoopa Valley Business Council Fisheries Department, Oregon Department of Fish and Wildlife, National Marine Fisheries Service, and other involved groups.

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